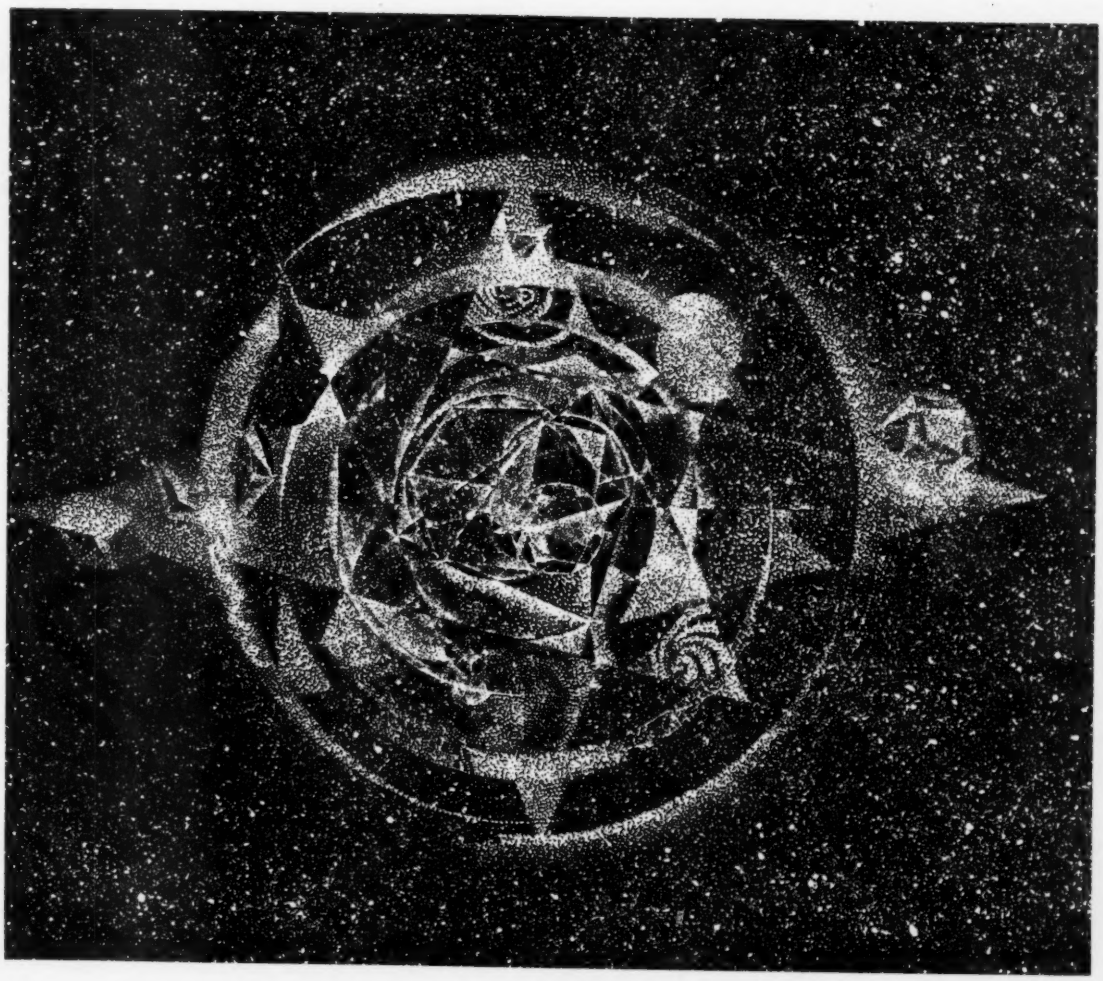
MAIN CURRENTS
IN MODERN THOUGHT

APRIL 1946

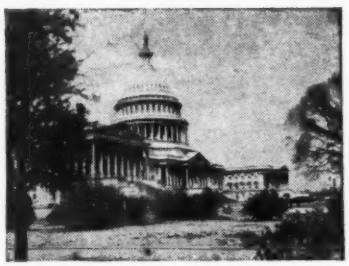


DIVINE IDEATION

A Drawing by A. J. GOUFFE

MAIN CURRENTS IN MODERN THOUGHT

A co-operative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.



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"Ah, but a man's reach should exceed his grasp, or what's a heaven for?" —BROWNING

Education and Society

Science and Philosophy

Books in Review

Grateful acknowledgment: Cover drawing, "Divine Ideation," & diagram page 40, by A. J. Gouffe, photograph on this page by Ralph Gardner, diagram page 46, S. C. Horsley.

MAIN CURRENTS IN MODERN THOUGHT is published quarterly to call attention to significant contributions to learning currently being made by leading workers in the multiple fields into which knowledge has come to be classified. It relates these advances to each other and to the classical and contemporary views of Eastern, European and American thinkers. It is designed to save time for the reader by providing a vantage-ground from which the whole world of knowledge may be surveyed and kept in proportion as it moves toward integration. *Its editors assume that the principles of art, the universals of philosophy, the laws of Nature and Man as formulated by science, and the truths of comparative religion, can be orchestrated into a harmonic, meaningful, ethical body of teachings which can be and should be made the central core of curricular study in the educative process at all levels of development.* In condensing text, square brackets [ ] indicate editorial interpolation. Three dots . . . in the text indicates a word, phrase or passage omitted in the interest of brevity or clarity. Other usages are standard. $3.00 a year. Contributors to MAIN CURRENTS enjoy full liberty of opinion and of expression in these pages.

IMPORTANT groups in the world of higher learning in this country have lately begun to concern themselves with a major task: the reorganization of the curriculum to the end that all knowledge shall come under observation by the student as a meaningful whole of ethical significance. Thus the achievement of security through technological means, initially for Americans, and later for the world, may be preceded by the restoration of effective philosophical insight and humane religious impulses required to give inner wealth to the generation which first wins leisure.

It may be said of such educators that they accept as true the description of education in the United States today provided in the Harvard Report, *General Education in a Free Society,* but they are not resigned to the postponement of the main problem therein described. We print further on three pages from that *Report,* from which we here abstract a few phrases, whether fairly or no the reader may determine for himself: ". . . the conviction that Christianity gives meaning and ultimate unity to all parts of the curriculum . . . is out of the question." "The question at bottom is whether the scientific attitude is in truth applicable to the full horizon of life . . ." "Thus the search . . . must continue for some over-all logic, some strong, not easily broken frame . . ."

Whether at Harvard provision will later be made to cure the evils which arise from the conceptual breakdown of our times remains to be seen. The *Report* is concerned with description and urgent repairs. The constructive proposals are admirable improvisations done in the rich atmosphere of Harvard's special resources in men and experience. But that they are improvisations, which must serve in the absence of the required "over-all logic", is made quite explicit. They must in any case so be taken, for the *Report* seems to rest upon an assumption that Europe is the fount of civilization.

Reading the recommendations concerning courses of philosophy at Harvard it is no injustice to say that here is revealed, as so often before, the essence of the weakness of the West, righteous in moral purpose, strong in chemical cunning and physical might, confused in concepts. The great philosophers are to be studied, six or seven to be selected; or we may take up philosophical problems and the usual stock issues could be examined; types of philosophy should be included; and finally, a new proposal, "the heritage of philosophy in our civilization. Western culture . . . a lake fed by the streams of Hellenism, Christianity, science and democracy . . ." is to lead up to "the doctrine of equality and the brotherhood of man."*

The study of *our* civilization is important, but when are we to begin to take seriously the larger ideas of civilization in its totality? In plain language, are Buddha and Shankaracharya two of the six or seven "great philosophers" to be studied in Philosophy A, and if not, when do they occur and in what atmosphere? As to stock notions of free will and causality, change and truth, have only Europeans had searching thoughts on these? Is it heresy to suggest that Europe is the prodigal son, and the world the patient parent of civilization, and that the present assumption of power by Russia and the orient arises fundamentally from our smugness? May it not be a fact that the former righteousness of the people of the West, which has led to the isolation of their religion from all others, is now working out fatefully in the form of the decline of the influence of all religion at home? Western culture may be a lake, but there is no reason why it should not connect at last with the ocean, as even Walden Pond manages to do. It is certainly now the eleventh hour, and no moment is to be spared by educators in their labors of finding and using an over-all logic which will be as much at home on the Ganges and the Yangtse as on those other noble streams, the Charles and the Cam.

It is desirable to cite here the opening sentence of the Preamble to the Constitution of the United Nations Educational, Scientific and Cultural Organization, which is to be located in Paris.

> The Governments of the States parties to this Constitution on behalf of their peoples declare that since wars begin in the minds of men it is in the minds of men that the defense of peace must be constructed; that ignorance of each others ways and lives has been a common cause throughout the history of mankind of that suspicion and mistrust between the peoples of the world through which their differences have all too often broken into war; that the great and terrible war which has now ended was a war made possible by the denial of the democratic principles of the dignity, equality and mutual respect of men and by the propagation in their place through ignorance and prejudice of the doctrine of the inequality of men and races; that the wide diffusion of culture and the education of humanity for justice and liberty and peace are indispensable to the dignity of man and constitute a sacred duty which all the nations must fulfill in a spirit of mutual assistance and concern; that a peace based exclusively upon the political and economic arrangements of governments would not be a peace which could secure the unanimous, lasting and sincere support of the peoples of the world and that the peace must, therefore, be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind. [The purposes and functions declared in the next Article include the preservation of "the independence, integrity and fruitful diversity of the cultures and educational systems of the States members of this Organization", and other enlightened provisions.]

In view of this expression of international resolution, a cordial welcome should be given in all colleges and universities to the suggestions about integration provided by small but actively conscious groups who see in the commencement of the United Nations Organization a meeting of world culture in an atmosphere of genuine mutual respect. If a collateral economic and political meeting of East and West occurs in an atmosphere of fair play, and if the long divorcement of Europe from the world context ends not by a war of utter ruin but through the replacement of imperialism by humane co-operation, then this country, thanks to such leaders in education, will be in a position to play its happy part in a world society. Education has an urgent

*As a corrective for the effusive and often lengthy but insignificant so-called reviews of the Harvard *Report* readers of MAIN CURRENTS are recommended to consult two thorough analyses by working educators in *High Points,* December, 1945, the organ of the New York City high schools: *Adam in the Atom World,* by Hyman Alpern, Evander Childs High School, and *A Democratic Philosophy of American Education,* Franklin J. Keller, Metropolitan Vocational High School, both of New York.

as well as an historic role to play in any event. For should the devious workings of imperialism continue as a malignant growth concealed under the United Nations Organization and bring about another war, ending as it must with Europe finally decimated and Asia once more the center of mass power, then we in the New World might still survive through having taken, however barely, the turning back to human solidarity in terms of a decent philosophy of life, and through bringing to an end the intellectual confusion which on so many campuses blocks understanding of man's place in the universe.

Those colleges and great universities showing conscious concern conceive the problem at levels of highest worth and fullest responsibility, and in terms growing more nearly identical month by month. Among such educators the question is no longer: Shall we tinker together a survey course or two, and introduce as much fundamental discipline as we can, and let it go at that? The issue has been instead boldly defined as that of resurveying all knowledge and experience, and of discovering valid co-ordinations which will draw the arts, philosophies, sciences and religions together *upon a basis of principles* honorable to every member of the family of subjects we call general and liberal education. This, in effect, is the new responsibility honestly confronted by conscientious educators, acting as American citizens, as historians perforce, many of them as bereaved parents resolved to bring public profit out of their private sorrow.

We need not here pursue the technical question of curriculum revision, and the training of teachers required by new demands, of interest to educators rather than to the general reader, save to express the hope that, in the interest of success, the actual procedure will vary a good deal from school to school, but that the central issue will continue to be everywhere in the foreground: the discovery of principles common to the four cultural disciplines and hence equally appealing to logic and to intuition, to stark social necessity and to humane impulses.

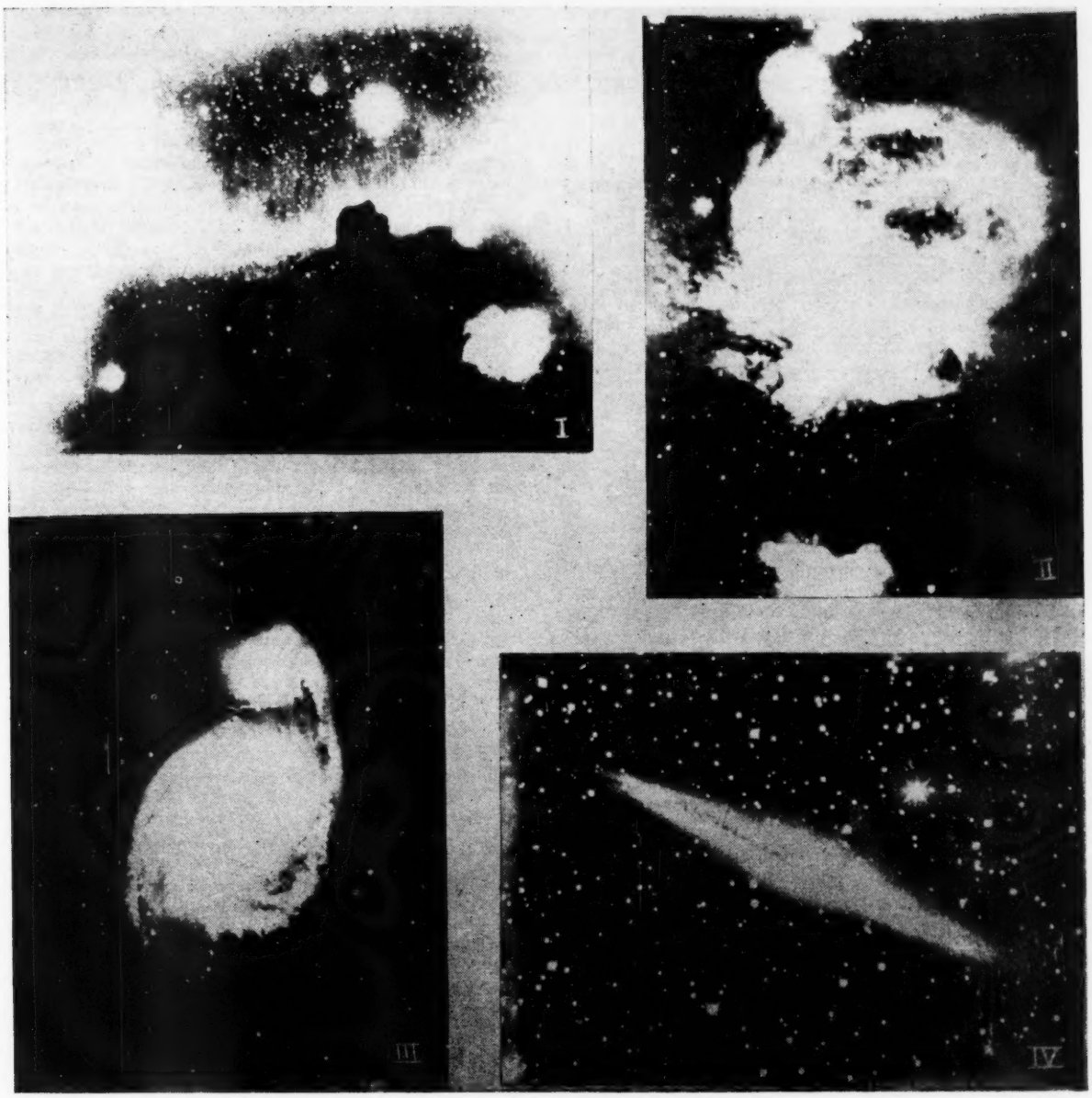
We propose to discuss the subjective aspect of the impending objective discovery of many cross-connections. For it seems obvious that since cultural gains are the product of human life, they have their roots, and can be integrated by reference back to that well-organized going concern we call a human being. Hence the task of improving integration in the curriculum is the same as the problem of getting increased understanding of human nature which, unevenly stirred to expression, has given rise to the disorder and disproportion in cultural riches which smother the student with senseless opulence. Before the rise of science in the modern sense the other three cultural moods have had historically several periods of effective mutual equilibrium, resulting in high civilizations. It is commonplace to say that science is our great gift and our equally great peril not because it is evil, but because it is prized out of all proportion. Its recent more and more violent uses in war, as an a-moral tendency in peace, have forced us to see four truisms: Science is governed by factual and not prompted by ethical standards. It has created machinery which is capable of destroying western society. It has enlarged knowledge until the jungle of data plunges the plodding mind into gloom so deep that law and order are seen as narrow and doubtful trails in the gathering darkness. Some of its advocates assert an almost arrogant claim for precedence over the other three older moods of man. In sum, science has overreached itself in such measure that if it were not for the hopes of freedom from want and slavery it has promised through its gift of technology and mass production, men of intelligence might well judge it to be too violent a force to be tolerated on terms equal to the peaceful and humane moods natural to culture in a true sense.

Before this came home starkly to the world on August 5, 1945, there had been many attempts to unify subjects through one great theme or department, such as history or sociology, and new attempts are current to group everything round some disciplinary subject. But to the institutions which have committed themselves to discover a world view for our times these are now not enough, for a reason which can be simply put: the essential challenge to our continued existence comes from the centralmost requirement of science, which exaggerates one small part of the nature of man (concrete mind) to insufferable dimensions of self-importance. If this aspect of our nature were not so closely allied to the ego-complex it would be easier to deal with our problem. But under the circumstances of fact, there is no solution which does not proceed from, and work further to promote, a wise understanding of man's whole nature and his relations to the whole of Nature.

It may be laid down as axiomatic in the problem that the more we concentrate chiefly upon training the intellect (by whatever means selected), the more we worsen our position by giving the case away to science in its most aggravated assumptions. Have the labors of Freud, Jung, Adler, Brill, the insight of Chinese sages and of Goethe and Plato, the genius of Patanjali, Panini and Shankaracharya, and the illumination of Jesus and Buddha passed by us without effect, that we can think in such naive terms to solve the problem? The whole psychosomatic structure is involved in the task of unifying experience by identifying the natural-moral principles common to all four cultural disciplines. Only upon this core of laws natural and spiritual can one central course of study be set up, in which full advantage can be taken of the most recent development in science itself in order to reunite the cultural family. When such a skeleton has been developed, there need be no further question except as to pedagogic procedure.

This is an issue fully appropriate to MAIN CURRENTS: What attitude in philosophy needs to be brought forward if hope is to be justified that we can comprehend in principle the whole appearance of Nature? Is the constitution of man so contrived that he can organize all knowledge around himself and need not be driven like some rat down a maze of job-specialization to earn a bit of cheese but no freedom at the end? We pass by, but only for the present, the immensely urgent question: How do we set up production and distribution so that this narrow specialization shall no longer be the whole life for some, and machine-minding for most, of mankind. We address ourselves solely to the question: How is human nature to be viewed and trusted, that we may in confidence try to marshall the whole before the mind of the adolescent and the young adult?

In this century it has become possible to make a new start, drawing no longer exclusively upon comparative religion, perennial philosophy, psychological matter, and other materials close to man in essence. In fact, so long as those were the only supplies the results are open to skeptical disregard. Now we have unmeasured gains from the physical sciences contributing to our knowledge of the background common to man and the rest of Na-



FROM DARKNESS TO LIGHT

Suggested manner of thinking about Plato's cosmology, especially as described in (but not limited to) the Timaeus, intended to set up the notion of progressive organization from ideal to real, in a scale of increasing grossness, parallel to physical changes observable in the stellar universe. The paradigm which follows is not intended to be taken as literal, but only schematic.

Stage O represents no differentiation. In Stage I we have Plato's union of Fire and Water, of course described by him at an ideal level. In Stage II the ordering influence of Air and Earth simultaneously with the beginnings of a spherical order, as described in the early part of the Timaeus. In Stage III Cosmos has emerged, still ideal in Plato, but reflected as the appearance of ordered motion in the spiral nebulae. Stage IV is that seen in a solar system, and implies a completed inner structure, corresponding to the Christian idea of spirit, soul, persona and body, all except the physical parts masked to sensory perception. A precise parallel to Plato's admittedly difficult Timaeus cosmology is well known as fundamental in Indian philosophy. We assume, with the Hindus, that the cosmos comes and goes in endless sequence. Stages of nebulae are as illustrated. No photograph, of course, is possible for Stage O, but we employ upon the cover of this issue a drawing suggesting the Platonic "Divine Ideation," which we owe to the kindness of the artist, Antoine Gouffe. The photographs are from the collections of Mount Wilson (I, II, & IV) and Yerkes Observatories, to which we make grateful acknowledgement.

Plato's Series: Read over and downward →	Stage O	→ I	→ II	→ III	→ IV (Present)
Situation obtaining between appearances of cosmoses: Purpose and matter one: or State of Maximum Entropy	Chaos	Absolute	Absolute	Daimonic world
	——	Logos	Heaven	The world of the Demi-urge
	—— ——	—— ——	Cosmos ——	Human souls and personalities
Physical stellar systems	Dark Nebula	Lighted Nebula	Spiral Nebula	Solar and planetary systems

ture. It is true that we have to do a very great deal, and much better, biological thinking in order to fill in the foreground to that background, that man may be placed intelligibly in the whole. Until this biological gap is filled in we shall continue to see the natural longing of man to understand himself exploited by a variety of fantastic cults drawing funds from uncritical people. The responsibility rests upon philosophers to meet these proper needs of humanity with concepts. Several books and articles in this issue of MAIN CURRENTS are intended to contribute to solid progress, in significant psychobiological studies. While such materials are being amassed, where shall we turn for a useful outline of the whole nature of man, the best precipitate of learning up to this time?

The answer, as seen from here, is in the old doctrine of microcosm: the view that man is, by right of highest evolution among living creatures, an epitome in very small of the principles in the universe. This doctrine, in noble form in Plato and in the Sankhya-Yoga, is quite different from anthropomorphism. There is no suggestion that we see lightning because that gleam in the cornea is lightning! The unity is to be sought in deeply buried principles common to man and to Nature, somewhere at the level of the properties of space-time-energy as a universal and harmonic whole.

This venerable "correspondence doctrine" is close to extinction in the west, as a philosophical principle capable of usefulness in the sense we contemplate. Those technically interested in its European status may consult George Perrigo Conger's indispensable *Theories of Macrocosm and Microcosm in the History of Philosophy* (Columbia University Press, New York, 1922). Though in the West it is nearly lost to view, in India it is necessarily central and very alive. What we propose here is to state as briefly as possible some of the Indian assumptions regarding the doctrine, and the relations it has with generally conceded partials of its principles which are alive among us, though not yet formulated as part of a whole concept of man's place in the universe.

Supreme or Absolute Being bears in Sanskrit the name Brahman. This is the crude form of a neuter gender word which correctly in the nominative is Brahma. It is to be sharply distinguished from the masculine form which differs from it only by having a long sounded vowel at the end: Brahmā. Brahman is thus the greatest word in Sanskrit language.

The root is Brh, literally "great" or, actively, "to swell" or "make great." Chatterji (his *India's Outlook on Life*) and others believe it to be the same as vrdh, cognate with the English "word" and bearing that meaning. Furthermore, the root brh is closely akin to the root bru, "speak," with which idea compare Greek "logos" and the place of this term in central New Testament passages. Again compare bhu "be," and bha and bhas, "shine" and bhas, "speak."

In passing we need to observe that these etymologies are fundamental matters, and no one familiar with semantics will discount the importance of getting to the root of the universal tradition about the Absolute, the Logos, and the like by such means. It is not a mere question of accomodating ourselves to the powerful facts of religious momentum or the aesthetic or sentimental appeal of phrases: "In the Beginning was the Word, and the Word was God, and the Word was with God." Our whole present thesis is vitiated if we suppose that only science in a narrow physical, not in a larger psychological and biological sense, can pronounce upon central worth. Either we propose to re-unite mankind, which is to say all racial or lingual cultures and all moods thereof, or we do not. If not, let us be intellectual Nazis openly. But if we mean brotherhood, then we must achieve a brotherhood of meanings for all ages and all climes.

Brahman, then, is not only the creator, but causeless cause, and it is inappropriate, according to Indian ideas (and St. Paul, as he said on Mars Hill), to worship this Ultimate with forms contrived by human ignorance or to predicate properties in the ordinary way. From that source alone arises all, both external worlds of sense-perception, and likewise inward experience of farthest reach and utmost depth. This is the "unknown," but by no means unknowable, "God," encompassing the whole by reason of being the whole. No exception can be made for the meanest part or episode in Nature or in human life. In this view deity does not only mark even a sparrow's fall but indeed is the sparrow and the fall.

Man is one with this, the whole. As organism, whether bodily, or mentally, or spiritually, he is one with it inasmuch as organism and environments are two parts of one whole. As consciousness, which is the gate to Atman or true Self, he is an immortal atom therein, and as such is capable of knowing through proper discipline what he may not know through physical organism alone, namely, the One as unmanifest in contrast with the same as manifest world. Putting the situation in modern language, Brahman is the universe as perceived in worlds and nebulae and islands universes, and no less the universe as dark nebulae and maximum entropy. It is with this absolute whole that man is one.

The Rig Veda (X, 129) addresses our attention to this causeless cause. The compactness and power of the so-called Creation Hymn touch even the least philosophical minds, if they respond to majestic poetry. The meanings buried within this one passage are profound in reach, and must engage us elsewhere if we hope to probe the meaning to the core. For the present it is enough to cite the mantram as an illustration of the conceptual scope of the sacred philosophy of the Veda.

"Non-existence then was not, nor Existence; neither Firmament, nor Empyrean there beyond:

"What covered o'er all, and where, or what was any resting place? What were the Waters? Fathomless abyss. 1.

"Then was neither death nor life, nor any fetch of night or day;

"That one breathed breathless by intrinsic-power, none other was, nor aught there-beyond. 2.

"In the beginning, Dark-Inert was hid by Dark-Inert. This all was fluid, indeterminate;

"Void by void was overlaid; That One was born by all-might of intension. 3.

"In the beginning, Will arose therein, the primal seed of Intellect, that was the first:

"Searching the heart thoroughly by thought wise-singers found there the kin of Existence in the Non-Existent. 4.

"What trace was stretched across below, and what above?

"Seed was, Allmight was; Intrinsic-power below, Purpose above. 5.

"Who knows it aright? Who can here set it forth? Whence was it born, whence poured forth?

"These angels are from its pouring-forth, whence then it came-to-be, who knows? 6.

"Whence outpoured this came to be, or whether one appointed it or not,

"He who is Over-Eye thereof in uttermost Empyrean, he knows indeed, or knoweth not. 7." *

* From: *A New Approach to the Vedas*, A. K. Coomaraswaamy, Luzac, London, 1933, pp. 54-56. This work by the great oriental scholar is a prerequisite to a proper understanding of Vedic lore.

From the above described cause arise the universe and universes, from within. The later Sanskrit literature, with lessening grandeur but with something nearer akin to our limited minds, describes in rich and varying imagery how the manifested worlds and creatures came to be. The whole of a universe is described as a "golden egg" (Hiranya Garbha), an image consonant with modern opinion that all the millions of island universes are finite but boundless spherical systems; and in this the One is imaged as himself, now as active creator. Here arises Brahmā, the masculine gender form, by means natural enough. And so by a series of transformations consonant with the best theology of all high religion, the present complex universe is brought into being, in the Hindu view, not alone physically. This outward-going process has a name (as a mode of conduct), *pravritti*, outward going or involution, the opposite of *nivritti*, return, evolution—for evolution in broad outlines is familiar in Indian literature as the *Avatar* or divine incarnation doctrine. The sequence of forms is exactly as provided by modern western science, but only six great biological stages (phyla) are described.

Conjoined with the involution-evolution doctrine is another, also conformable in a certain degree to modern scientific notions. This is the concept of the *kshudra-brahmanda*, meaning, freely, what we mean when we say microcosm and speak of man being made in the image of God.

Because Brahman is all, it follows that any evolving individual creature can only approach that nature. There is no other goal since there is no other at all. Human beings are held to be high in the evolutionary rank in the physical world. Hence the Hindu view is that every part of the body (and, of course, of the mind, soul, and spirit) have an exact correspondence with some significant principle in Nature. The idea is agreeable to the well-known modern belief that phylogeny recapitulates ontogeny.

It is further held that since mind and soul are likewise modelled upon appropriate ultraphysical principles of the One, therefore body and mind correspond part for part through this Unity in which both inhere. There is in physiological science today no doubt that psychic disorder leads to physical disturbance, as when worry leads to stamach acidity and then to stomach ulcers, or when psychic-based allergies appear. But here two elements are missing in modern thought, both present in the Hindu attitude. First, we moderns have not probed far into the wholesome and normal relations of mind to body, having been over-concerned with unbalanced endocrine and other pathological states. The second hiatus makes our thinking even more disparate with that of India. We do not in science conceive mind and soul to have existence independent of body, and as fitted parts of a whole evironment natural to them, in the way we admit physical body life to be exquisitely adjusted to its own material environments.

Man, as a microcosm, however, is explicit in Indian thought and essential to it, and the following passage is one of hundreds which might be chosen to illustrate it from a vast literature, which depends for understanding upon that doctrine, in the sense just described.

The passage is a ritual instruction from the Sathapata Brahmana (XI, ii, 6. 13; *circa* 1000 B.C.). It distinguishes two states of mind as appropriate to the Brahmin priest while he is conducting certain rites. He may direct his thoughts to the gods (devas), in which case the result will be of a certain character; or he may direct his art scientifically and with precision to his relations as a microcosm to the macrocosm. The passage evaluates the latter as the higher worth:

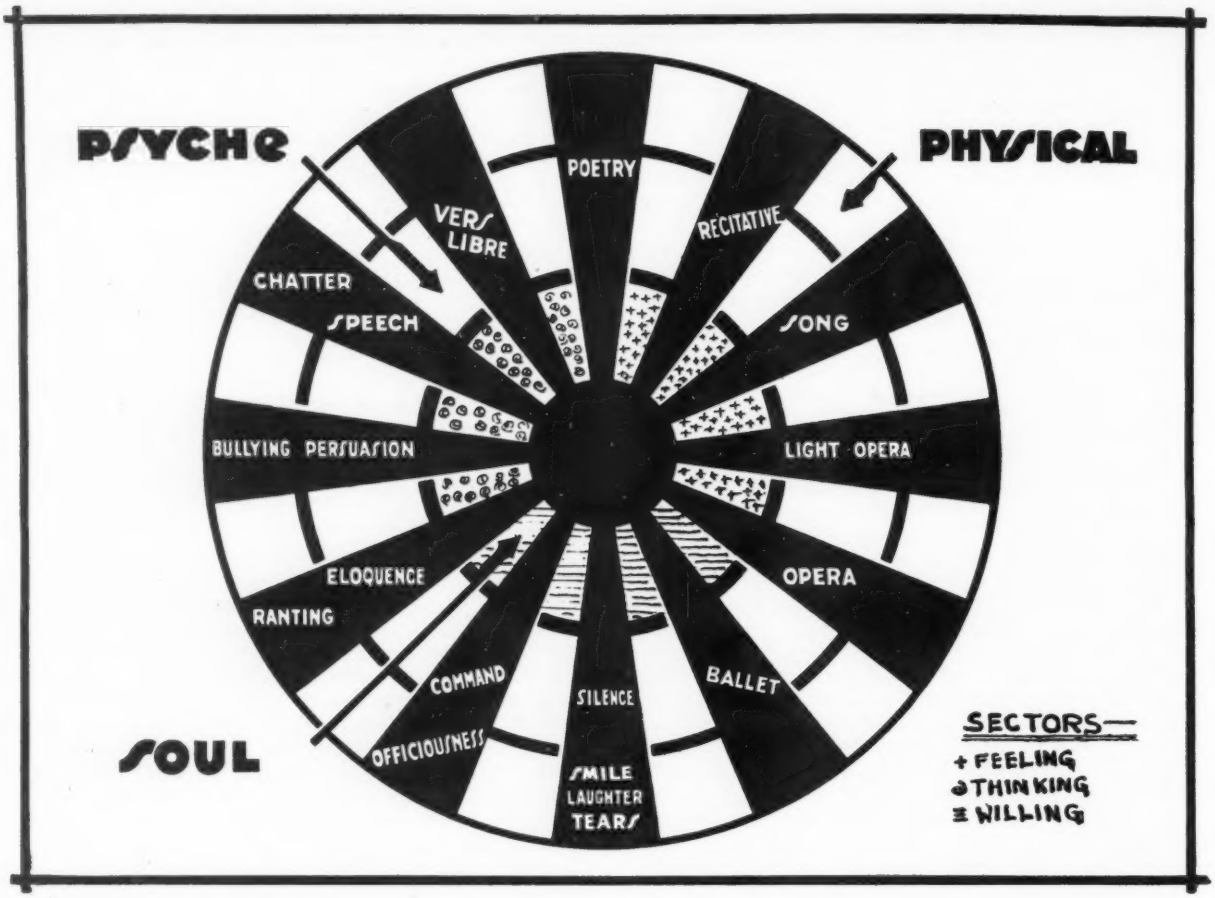
"One should say, 'This is the deva-yaji', and 'This is the Ātma-yaji'. He is the Ātma-yaji (literally, self-sacrificer) who knows 'By this rite this member of my body is rectified', 'By this rite this member of my body is restored', ... He is the deva-yaji (god-sacrificer) who thinks, 'I worship the gods with this, I offer it to the gods.' . . . . (The latter) does not conquer so great a world as the other."

Plato, of course, most memorably in the Timaeus, pursued precisely the same theme, and to the end maintained that the soul of man is spherical, as the universe is spherical; that both are harmonic, and the body, in principle, harmonic with them. It is Aristotle who wrenched us from the older context of thought. We append to an illustration of that marvel of the heavens, the great dark nebulae in Orion, a miniature sketch coordinating very roughly the sequence in the Timaeus, with an evolutionary sequence in the stellar systems, for more provocative thought.

For the present, respect for experiences of mankind, broader than physical science alone provides, must wait upon a full restoration of European mentality to the world context, which is proceeding apace however much we resist the confluence of cultures from India, China and Asiatic Russia, from learned Jewry, from the Islamic heirs of Chaldea, Judea and Egypt, from the regions where animism still lingers, and from Europe and the New World.

The greater the rank of the scientific thinker, the likelier he is to see the need of unification. "I consider," says Joseph Needham in his appendix to Charles Earle Raven's *The Creator Spirit* (p. 288, Hopkinson, 1927) "that the scientific method, with its dependence on the logic of induction, its constant employment of the statistical process, its inevitable intellectual analysis of its subject, and its essentially metrical nature, cannot be considered the only way open to man in his longing to move forward toward the essence of the world. To regard it as the singular approach, or even the principal path to Truth would be to fall into the pit of scientific naturalism out of which we have been so diligently climbing since the Victorian period. It would be to succumb to what Whitehead calls the 'Fallacy of Misplaced Concreteness'. We must believe that other kinds of experience give valid accounts of Reality, and that forms of human activity, such as Philosophy, Religion, Aesthetic appreciation and Poetry, produce autonomous interpretations of the nature of the universe." This distinguished biologist goes on to define mechanism (already dead since Needham wrote) as a useful hypothesis, not as a theory or metaphysical system. Its value is due to its conformity to measurement systems. Needham reminds us that Lotze (*Microcosmos*, p. 399, Clark, Edinburgh, 1894) says that mechanism is a universal but a secondary in cosmos. If so, what is the ultimate? We cannot answer this question, but the universals of Logos or consciousness and of cosmos or life with which Plato and the Hindus were concerned may be taken as primary or tertiary (if energy or chaos is secondary), as the first triplicity of that ultimate. Such, at least, is the Indian view.

From within their own severely self-restricted area physics and biology offer little for purposes of this discussion. However, one important bit of evidence that



THE HUMAN VOICE

The above diagram is intended to suggest the orderly and dimensional resources for communication in man, through voice, gesture, and posture, and to set up linkages between the aspects, as well as the depths, of the intelligible principle which demands these forms of expression and uses these varied means of communication.

The diagram consists of three sectors (see key, lower right), referring to feeling, thinking, and willing activities. Will is here defined, for this purpose only, not in the broad sense of conation (after Kant, Hamilton, Ladd and others), but as an inhibitive and selective self-control and self-assertion in circumstances which demand something distinct from immediate intellectual or immediate emotional activity. Feeling and thinking are used in a similar channelled sense.

The diagram also indicates that there are levels of expression of each of these channelled moods, indicated not by angular arrangement, but by concentric circles, identified by the terms physical, psyche and soul. The term psyche is exact in the Freudian sense, but not necessarily limited to his identifications. The term soul is used in the sense in which Jung uses it (his animus), and it is related also to certain crucial Gestalt experiments, as well as to other exact aesthetic activities, and to concepts such as Plato's notion of the true, the beautiful, and the good, in the archetypal sense.

It is to be noted that a fourth depth is suggested, the center. Such ideas as the monads of Leibnitz, the spirit of Christian theology, the Atman of Indian philosophy, may be attached to this level. For the present the precise term self-consciousness may be applied. We thus suggest a series in which the physical periphery is the deepest unconscious and the center is the most nearly related to conscious selfhood.

Terms are given to twelve forms of vocal and gestural expression at the level of psyche, and to a few at the peripheral level of body.

In the mid-point of the thinking sector we have intellectual speech. As we move away from this channel clockwise toward the feeling sector, rhythm begins to appear as cadence in free verse. Free verse is a form as valid and important as any other poetic mode, though its rhythms are appropriately of a simple order.

When we come to the boundary of the thinking channel, where it fuses with feeling, the cadence becomes the true meter of poetic expression. If we continue the intensification of the feeling, the necessity for sustained tone appears, and one further step leads to song, central to feeling. There is an interesting connection between consonantal structures at the simple language level and wealth in vowels, appropriate to singing tones, well worth extensive exploration in terms of the world's languages and racial characteristics.

If we start again with grammatical speech, however, and go counter-clockwise, we have a sequence in which first persuasion and then eloquence appear, with the approach and transition to willing, which then becomes command—few words, and those expressive of orders and determination. Continuing, we come to silence, which is self-control of the tongue, and has an identity with the caesura of speech and poetry, and the rest in song, and is obviously an extended form of self-control such as can contribute to good diction if present, and result in slurring when absent. We may then say that the central channel of the will in speech completes the triplicity of consonant (so important in intellectual language), vowel (vital to song) and caesura-rest, the three basic components of spoken tongue.

man is sufficiently complex, in body and mind, to serve organically as a microcosm, is provided by the experiments available in the Gestalt psychology. Among the experiments anyone may make upon himself are the so-called optical illusions investigated by Wertheimer and others, of which Necker's cube was the first. Examples of these were printed in MAIN CURRENTS, vol. 4, no. 1.

Yet even when these newer developments carry us far into the relationships between gross and subtler parts of the constitution of man, there will still remain basic problems to be solved before the atomism of science can be united with the religious idea that man is of God. We cannot pursue all these fascinating challenges into their exquisite modulations in the Indian philosophies, where the unity is triumphantly brought off. We may rest the reasoning here by observing that there is really no difficulty today in conceiving how a Leibnitzian self-conscious point-monad is to be viewed in relation to a complex of Platonic soul and Freudian psyche, thanks to progress in studies of particle-and-wave identities.

In whatever manner this concept may be finally achieved, it is clear that the gap in knowledge of any process relating consciousness (taken atomically) to a complex body is just as great on the physical side as it is on the psychological. Yet physically, such a concept is not held to be impossible. We are forced to entertain it from the facts. Clifford C. Furnas (*Next Hundred Years*, p. 77) collated various estimates of the number of cells in an adult human body, and suggested a million billions (English style — 1,000,000,000,000,000,000) as a representative figure. Present estimates are lower. The exact number is not important. These are organized initially from one cell, the fertilised ovum. But what is this original cell, with all its daughter body-cells? It is, and each of them is, a complex of great protein molecules, in mass chiefly carbon, oxygen, hydrogen, nitrogen, phosphorus and sulphur; each of these is composed of electronic units or wave-packets, so that the body is really a complex of units possibly 1.8×10^{28} wave packets instead of 10^{13} or 10^{16} cells.

If one cell leads to the organization of a trillion other cells, there is no reason to doubt that in some unique particle may be the pivot of an ovum's organization, and hence of the whole. This may even be a non-material point, the center of various gradients, just as in many crystal cells the symmetries focus in a point unoccupied by any atom. Today there is no mathematical difficulty in conceiving a single point through which a given local field of energy can organize material particles, and the local, or individuation field, is established as biological fact.

In the case of a human body we must further assent to the idea that mind energy is (broadly) like physical energy, and mind organization (broadly) like biological organisms, even if we conceive the unique atom as being the focus of special properties of the field, more than the physical organism can embody. Biological organisms free, and employ, energies at the chemical molecular level. Why should not mind similarly release and use energies at the atomic or sub-atomic level? Only the smallest of atomic breakdowns would be needed for such purposes of the psyche, and there is ample supply. "Four grammes of hydrogen atoms exceed by three centigrams the helium produced, corresponding, according to Einstein's formula, to the liberation of 7×10^{12} calories," Henry Hubbard, Secretary of the United States Bureau of Standards, observes (*New International Encyclopedia*, Supplementary Volume 2, p. 1256, 1930).

And just as there is plenty of energy for mind, there is also of room for mind: the distances between the particles of a human body when taken proportionately to the particles' diameters are on a solar scale, and what may go on psychologically between the physical particles is anybody's—and certainly the Hindus' and Plato's—right to surmise. And (finally), if it seems that the stage-by-stage reduction of organic and psychic systems to a final monadic point of consciousness surrounds that point with a complex which it can hardly be expected to control successfully, the reply is that this is exactly what we can observe in human conduct: We are the intimate witnesses of a vast going-on in ourselves. The intimacy leads us to suppose we have self-control. Freud (to begin with) makes clear we do not really possess this at the libido level, at least. Any physiologist knows how little we control bodily processes, and that little only through psychic intervention. As for control of our soul powers, we surely have scarcely begun the task of self-

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Continuing counter-clockwise, we arrive next at bodily and gestural expression, still without speech, ballet (though pantomime is an equivalent); then at what could be another of the important borderland or social arts, opera (associated in this sense with eloquence and poetry, in older cultures at least), and so over into light opera, in which songs so often are featured above dramatic values.

In the outermost circle, at appropriate points, a few recognized psycho-pathological uses of the voice are indicated. Others could be arrived at. Speech, as an uncontrolled physical habit, becomes idle chatter, persuasion bullying (a verbal form of coercion), eloquence rant, and due commands egocentric officiousness. Herein the unconscious in various ways and depths is seen taking over. The most provocative of these items is indicated below the word silence. It goes without saying that smiles, laughter and tears are not necessarily pathological. But we are all familiar with the conversion of the sense of fun at the level of a smile, into hilarious laughter which, sufficiently long sustained and intensified, may result in complete loss of self-control and eventual lacrimose hysteria. The location of the latter intense phenomenon physiologically in and below the diaphragm, the centering of song in the heart and lungs, and speech (particularly in whispered form) in the head and throat are matters worth pursuing to those interested in the microcosm doctrine. For those of eclectic interests the opinions of Gautama Buddha about laughter form a useful adjunct to puritan and catholic tendencies in mankind.

No terms are allocated to these channels at the level of soul. Herein would fall creative forms of literary activity which are appropriate to thought at the level of reason, of philosophy, of wisdom; art at the level of pure intuitive insight supported by rich experience and exact knowledge, interestingly discussed by Ruskin in the fourth volume of Modern Painters; and high-level forms of ethical effort and expression.

The present purpose is merely to suggest that an equation can be worked out in the manner of the periodic table and other abstracts of natural order familiar in scientific literature, here between actual and identifiable forms of oral, gestural and bodily expression and the total resource of human nature.

For it is evident that education has as its raw material a human being. The more clearly we can define proportionately the essential features of that creature, the more certain becomes our pedagogical procedure. In addition to this main use, the above diagram and discussion has evident bearing upon an important new enterprise, the study of semantics. It has equally important bearing upon the classical forerunner of semantics, the Logos doctrine, so central to a proper understanding of personal and impersonal elements in deism.

awakening. We have taken over a little responsibility to exercise and feed our bodies. But the task of directing our psyches and souls we still feebly resign to the unknown. Modern man is in the case opposite to that of Prometheus: chained in psyche to mounting desires, while free a little in body. But, like Prometheus, he may be a Titan and venture to assault the heavens and to know the whole. Educators who pursue that course in their present and pressing duties of curriculum revision are likely to be justified of their faith. F.L.K.

VARIOUS VOICES

The Conceptual Breakdown

[IN THE FIELD of higher education there are] three self-evident propositions. The first is that the educational requirements of the country are greater than ever, in the sense that the condition of the world puts a greater strain on the character and intelligence of the American citizen than ever before in history. The second is that the educational opportunities open to our people are greater than ever, in the sense that there are more schools, colleges and universities in this country than anywhere else in the world. This country is the only one, too, in which secondary and higher education are free. The third self-evident proposition is that the results achieved by the American educational system are poorer than ever. . . . The very process by which education has been opened to the mass of the population . . . has resulted in obscuring the aims of education and the consequent degradation of educational standards. . . . The consequences . . . may be summed up in the word "trivialization." . . . The higher learning can be saved only if a few universities have the strength, the tradition, and the consequent independence to demonstrate what the higher learning is. This requires a willingness to discover and pursue unswervingly the aims of education, to reëxamine the methods, content, and organization of education, and to do what ought to be done to clarify and improve education even if it involves the loss of income or popularity.

But this is not the whole story. Trivialization is only one of the two characteristics resulting from the centrifugal forces at work in higher education. Disintegration is the other. . . . a by-product of the admirable democratic aspirations of American universities to advance knowledge and to elevate the professions. This aspiration has required intensive specialization in research and in training. . . . No community is possible without communication among its members, and communication means common understanding, resulting from a common language, a common tradition, and a common stock of ideas. The disintegration of education both reflects and causes the disintegration of society. . . . The incredible achievements of specialized research and technology . . . should not blind us to the fact that our knowledge of where we are going has not kept pace with the development of our means of transportation. Our control over nature seems far greater than our control over ourselves or our ability to use our control over nature to increase the humanity of our lives.

From *The University*, an address to the Citizens Board by Robert M. Hutchins, Chancellor of the University of Chicago, 1945.

Wanted: The Over-all Logic

THIS, THEN, or something like this, is the present state: an enormous variety of aim and method among colleges as a whole and much the same variety on a smaller scale within any one college. This condition, which seemingly robs liberal education of any clear, coherent meaning, has for some time disturbed people and prompted a variety of solutions. Sectarian, particularly Roman Catholic, colleges have of course their solution, which was generally shared by American colleges until less than a century ago: namely, the conviction that Christianity gives meaning and ultimate unity to all parts of the curriculum, indeed to the whole life of the college. Yet this solution is out of the question in publicly supported colleges and is practically, if not legally, impossible in most others. Some think it the Achilles' heel of democracy that, by its very nature, it cannot foster general agreement on ultimates, and perhaps must foster the contrary. But whatever one's views, religion is not now for most colleges a practicable source of intellectual unity.

A second solution has been sought in the tradition of Western culture as embodied in the great writings of the European and American past. There seems much that is fertile in this view and we shall revert to it. But at first glance it appears to collide with two difficulties: first, the great disparity of taste and ability which exists even among college students (not to speak of high-school students, to whom, as repeatedly said, any truly valid scheme of unity must also extend) and, perhaps more important, a doubt whether the spirit of innovation and change expressing itself in a thousand modern forms is not itself as fundamental a part of Western culture as the spirit of tradition.

A third solution recognizes precisely this spirit of change. It centers on contemporary life, and, casting off the formal divisions of knowledge, tries to organize knowledge around actual problems and questions which young people may be expected to meet in mature life —health, vocation, family, social issues, private standards, and the like. The difficulty here is a somewhat naive dismissal of the fact that a great many people have contributed over a very long time to human knowledge, which in consequence has a dignity, almost an austerity, calling for some respect. Moreover, since conditions change, what assurance is there that the problems which students study will resemble those that they will meet? In general, relevance to the present seems more valid as a point of view expressing a teacher's outlook and emphasizing the inevitable bearing of knowledge on life than it is as a unifying principle.

Finally, the pragmatist solution sees in science and the scientific outlook this saving unity, urging that what is common to modern knowledge is not so much any over-all scheme as a habit of meeting problems in a detached, experimental, observing spirit. Yet, if not the philosophers of pragmatism, at least their disciples seem in practice, if one may put it so, not pragmatic enough. That is, there is always a tendency in this type of thought to omit as irrelevant the whole realm of belief and commitment by which, to all appearances, much of human activity seems in fact swayed. And if pragmatism be extended to include this realm of value, then it runs the danger of losing its scientific character. The question at bottom is whether the scientific attitude is in truth applicable to the full horizon of life, and on this question there is, to say the least, uncertainty.

Thus the search continues and must continue for some over-all logic, some strong, not easily broken frame within which both college and school may fulfill their at once diversifying and uniting tasks. This logic must be wide enough to embrace the actual richness and variegation of modern life—a richness partly, if not wholly, reflected in the complexity of our present educational system. It must also be strong enough to give goal and direction to this system—something much less clear at present. It is evidently to be looked for in the character of American society, a society not wholly of the new world since it came from the old, not wholly given to innovation since it acknowledges certain fixed beliefs, not even wholly a law unto itself since there are principles above the state. This logic must further embody certain intangibles of the American spirit, in particular, perhaps, the ideal of coöperation on the level of action irrespective of agreement on ultimates—which is to say, belief in the worth and meaning of the human spirit, however one may understand it. Such a belief rests on that hard but very great thing, tolerance not from absence of standards but through possession of them.

From *General Education in a Free Society*, Report of the Harvard Committee, Harvard University Press, Cambridge, Mass., 1945, pages 39-41.

Education for a World Society

As a result of the tremendous social forces released by the war, the common man is going to have more to say than ever before respecting the type of political state in which he lives, the form of economic system in which he produces and distributes the fruit of his labor, the educational system under which he provides for the instruction of his children, and the social order through which he strives to work out his destiny . . .

What of education as a social necessity? . . . If the common man is to exercise more and more power, must he not possess those qualities of mind and faith and character without which the exercise of power is a threat to, not a guarantee of, the continued human progress? Clearly, it is imperative that all America come to see the nature of the essential functioning of free education in a free society . . .

If the extraordinary provisions for popular education in America are to service the essential needs of a democratic order certain educational outcomes must be clearly recognized and successfully achieved . . .

We must make education connect more directly and explicity with the forthright pursuit of truth . . . Too many students move through our schools and colleges without ever acquiring a first hand acquaintance with what it means to seek truth honestly and faithfully . . . The love of truth and the disinterested pursuit of it lie at the very heart of freedom . . .

We must do better than we have in imparting through formal education a widespread social understanding . . . Information is not enough. We must build information into knowledge, and knowledge into understanding . . .

We must make education minister more effectively than it has to an expanding social sympathy. Mankind is being knit more and more closely together. We must all come to see more clearly the nature and force of the common bonds of humankind the world over . . .

The idea that we seek education in part to lighten our workload is basically fallacious. The more education we get, the greater are our obligations to serve. We must develop through popular education a philosophy of work in which productive labor becomes both a duty and a privilege . . .

Finally, we must in education in America come to grips with the everlasting moral imperatives of a free society . . . Formal education cannot possibly be regarded as a moral social function. It is high time that our schools and colleges dealt more explicitly and responsibly with their obligations to moral order in American democracy.

From "The Challenge to Popular Education," the Moral Order in American Democracy, an address delivered by Edmund E. Day, President, Cornell University, at Commencement, June 25, 1944.

The Philosophy We Need

Probably no department in the American college is in greater need of reorganization and reform than the department of philosophy. The impact of the war has made us increasingly aware of the neglected field of values and religious faith. Our imperfect understanding of what we are fighting for reflects our confusion as to the goals of education and life and our ignorance of the nature and needs of men and society. If, however, philosophy is to resolve this confusion and dispel this ignorance it must be purged of much of its technical language and its preoccupation with meaningless abstractions. We are all philosophers and we all have beliefs by which we live. What we need is a simple non-technical course in philosophy and religion focused on the problems we meet in everyday life.

President W. P. Tolley addressing the Syracuse University Board of Trustees, 1945.

Seven types of people

Seven character traits were described in unusual terms by Dr. Charles Morris, associate professor of philosophy at the University of Chicago, in an article in Fortune, September 1943: Buddhist, Dionysian, Promethean, Apollonian, Christian, Mohammedan, Maitreyan—the last referring back to Buddha's declaration, in response to lamentations of his disciples that the death of their teacher would leave them desolate. Gautama said that the next Buddha after him would be Maitreya, "he of pity". The identification of these types is a matter of considerable interest, and as treated by Dr. Morris they are in several cases a commingling of theological elements, popular ascription of qualities, and (as to Maitreya, at least) precise descriptions de-

rived from the source. The article is based upon a book, *Paths of Life,* by Dr. Morris, to which reference may be made for more extended discussion. He regards the emerging attitude of Maitreya, "friendly", as a unique and complex synthesis of all the others, and describes the modern American as a kind of Hindu *trimurti* of Promethean, Apollonian and Christian. He identifies the latter to some extent with the Buddhist view of duty; humbleness and simplicity are important elements. One misses in this interesting discussion a reference to one of the most important features of Buddha, namely, his delight in life and his sense of it as a play—the embodiment of the central thought of the Hindu about the world, taken as a sport, the *Lila.* All in all, however, the article broaches a very important department of thought, comparative religious psychology, of which we have all too little. E.J.

Liberals Must Organize

TENSIONS BETWEEN businessmen and liberal intellectuals must be resolved by enlightened, realistic coöperation in the public interest, we declared in one of a series of messages we published in recent issues of the New Republic and the Nation . . . A large mass of letters from opinion molders and group leaders . . . emphasized the need for a synthesis of opinion which will result in sensible, middle-of-the-road thought and action . . . Some liberals said of liberals: "They state their ideas too subjectively . . . They let political parties use them for smear purposes." Some businessmen said that too many businessmen have a narrow point of view: "They are blind to the revolutionary ideas sweeping the world"; "they need to expand their reading habits to include social interest as well as business publications." "There is an Old Guard," writes an industrialist, "that must repent; the strict adherence to the profit-motive must be toned down." Businessmen agreed that there must be a recognition of the interdependency between management and men. "Liberal businessmen must organize—apart from the NAM and the Chamber of Commerce—if their influence in these organizations cannot become effective." These letters show conclusively that there is a coincidence of interest between the liberal intellectual and the businessman. A sincere sympathy can be established in their relationship. These things must be done and there are *some* businessmen and *some* liberal intellectuals to do them.

From "A Plain Talk to Liberals—Reader Response," one of a series of messages on the public interest and public relations by Edward L. Bernays, Counsel on Public Relations, *The Nation,* July 1, 1944.

Work Must be Meaningful

THE ASSUMPTION that a man can express his real self in leisure-time activity and be happy in it contains a fundamental psychological error. Leisure, no matter how profitably employed, is no substitute for work. It is by demonstrating his worth as a worker, not by his prowess in recreation, that a man wins self-respect and the respect of others. Only through work does a man arrive at meaningful living. . . .

If we desire social stability we should not blink the fact that countless numbers of people throughout the world are bound to jobs which by depriving them of a sense of participation in a creative process tend to starve their deeply ingrained work instincts. . . . May it not be that much of our economic and social unrest really stems from the truth that, for many, the working hours are a socially starved part of the day; that the forms which labor unrest takes may be but symptoms of a hidden discontent deeper than hours and wages, namely, the fact that the job does not provide an adequate work experience? . . . The solution must be found in modifying the relationships under which men work. How to regain that richness of experience which our forefathers enjoyed when they were subduing a continent is a matter of concern to alert industrial leaders. It is the heart of the problem of industrial relations and personnel management. The subject requires for solution both good will and extensive scientific research. The answer is not apparent. One thing is clear, that man's primeval urge to express himself by constructive work will not be bought off by the blandishments of leisure . . . Only through work does one gain the capacity for leisure. It is through work that we immortalize ourselves, that we contribute anything that we can believe will live afer us . . . .

Work is not an ethical duty imposed upon us from without by a misguided and outmoded Puritan morality; it is a manifestation of man's deepest desire that the days of his life shall have significance.

From "The Problem of Leisure in an Industrial Age," an Address delivered by Dr. Harold W. Dodds, President of Princeton University, at the Baccalaureate Service, June 19, 1938.

The Golden Rule

Buddhism. Hurt not others with that which pains yourself. Udanavarga, 5, 18.

Christianity. All things whatsoever ye would that men should do to you, do ye even so to them: for this is the law and the prophets. St. Matthew, 7, 12.

Confucianism. Is there any one maxim which ought to be acted upon throughout one's whole life? Surely the maxim of loving-kindness is such. Do not unto others what you would not they should do unto you. Analects, 15, 23.

Hebraism. What is hurtful to yourself do not to your fellow man. That is the whole of the Torah and the remainder is but commentary. Go learn it. Talmud.

Hinduism. This is the sum of duty: do naught to others which if done to thee would cause thee pain. Mahabharata, 5, 1517.

Islam. No one of you is a believer until he loves for his brother what he loves for himself. Traditions.

Jainism. In happiness and suffering, in joy and in grief, we should regard all creatures as we regard our own self, and should therefore refrain from inflicting upon others such injury as would appear undesirable to us if inflicted upon ourselves. Yogashastra, 2, 20.

Sikhism. As thou deemest thyself so deem others. Then shalt thou become a partner in heaven. Kabir.

Taoism. Regard your neighbour's gain as your own gain: and regard your neighbour's loss as your own loss. T'ai Shang Kan Ying P'ien.

Zoroastrianism. That nature only is good when it shall not do unto another whatever is not good for its own self. Dadistan-i-dinik, 94,5.

From *The Eleven Religions,* edited by Dr. Selwyn Gurney Champion, Dutton, New York, 1945, to whom we are indebted for kind permission to print this extract.

AN INTEGRATED CURRICULUM*

Carter Davidson

THE DESIRE to integrate ourselves with the world in which we live, its physical environment, its social milieu, and its intellectual currents, is a basic human urge. How often we have heard people say they wished they had the time to pull themselves together, find out where they belong, see how they fit into the scheme of things, or find out how it all hangs together. Modern communications and transportation have made our connections with the world so manifold and the problem of arranging these in orderly fashion has grown so stupendous that some people are completely baffled by the problem, and despair. Others look back to a time in the past when life was simpler, or seemed so, and try to adapt the thought patterns of those days to achieve this integration.

These people say that at least twice before in the history of man a people have achieved the proper relationship with the environment around them. First was in Athens, in the age of Pericles, when civilization seemed to reach a peak, and Plato and Aristotle provided a method for arriving at the truth and arranging it in convenient categories. The second period was in the 13th century of the Christian era, when mediaeval thinkers, through St. Thomas Aquinas and the other school men, built a pattern of life based on the authority of Aristotle, the church fathers, and the revelations of the Bible. Aristotle became the bridge between the Greek and the mediaeval world.

It is interesting to note that two of the most challenging experiments in curriculum construction of our day are based upon these earlier integrations. The St. Johns' College plan has chosen the language, literary masterpieces, and scientific discoveries of the Greeks as the basis for its curriculum and the core of "The Great Books." The University of Chicago, at least in its Hutchins-Adler manifestations, has preferred the system of Thomist-Aristotelian mediaevalism. I will admit that either of these methods is a possible way of achieving an ordered plan of education, but I can not avoid pointing out that there is nothing new in this return to the past. The 18th century in England, France, and America built up its educational program upon this basis with the result that the colleges and universities found themselves entirely outside the core of daily life and unable to influence the course of human actions.

We have now reached the point in the history of America and of western civilization when we must achieve new integration of the complex human personality with its world—using the new sciences, the new arts, and a revised philosophy and religion adapted to the needs of 20th century living. The faculty of Knox College has undertaken to attempt this new integration starting this fall. The results may have significance far beyond the confines of our own campus.

The faculty began with certain convictions which have grown out of many years of teaching experience. They were convinced that no mere "survey" of the informational content of the sciences, social sciences, and arts would meet the needs of the students. Surveys, because of the vastness of the area which they attempt to cover, have a tendency to be shallow, and flowing at such a speed that they leave very little time for any sediment to sink to the bottom. As frequently given, surveys also tend to become a mere group of segments of knowledge tied together only by the fact that they are part of the same course in the catalog. Frequently the parts are taught by different members of the faculty, without any reference to what has gone before, or what is to follow, and without adequate continuity of instruction.

For the past five years the Knox faculty has gone through a period of preparation for the new program by participation in three integrated courses. The first was a course required of all freshmen in the Middle West, covering the geology, geography, biology, and ecology of the eight states of Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, Michigan, and Ohio, followed by the history, political institutions, sociological problems, economic developments, religious ideologies, and educational experimentations of this region, and concluding with a study of the literary expression, architectural and artistic achievement, and music which the area has produced. Although the main lectures in the course were given by the heads of the various departments concerned, no lecturer was allowed to come in, give his lecture, and depart. He was required to attend all the lectures in the course and conduct a discussion group throughout the year. The staff in this course, numbering more than a dozen faculty, met together regularly each week and discussed ways in which the course might be improved and more closely interrelated.

Looking back on our five years of experience with the Midwest course, we believe that it has been remarkably successful in producing an attitude of integration which has affected the entire program of the College. From my personal point of view, I can assure you that the preparation required of a faculty member in teaching the course was almost the equivalent of a new college education. The faculty were so convinced of its merits that our new program is largely an outgrowth and expansion of the regional-course idea.

Our second experience with integration came through the assignment of a large unit of men in the Civilian Pilot Training Program, which later became the War Training Service of the Civilian Aeronautics Administration. Our faculty decided that instead of bringing in a new staff to handle this program, they would prefer to learn the new materials and teach the subjects themselves. As a result, a professor of Spanish was teaching radio code, a professor of art was handling aircraft identification, a professor of philosophy gave instruction in aircraft engines, and a professor of English taught meteorology and navigation. Physicists and mathematicians were allowed to teach their own subjects. Perhaps this was a handicap to them in learning to achieve a new integration.

Our most recent experience came with the assignment of a large Army Air Forces College Training Program. The adaptations achieved in the CPT course made the new adjustments possible, and physics has included in

* Reprinted by permission from *Progressive Education*, November, 1944. The author, then President of Knox College, is now President of Union College.

its staff members of the department of art, philosophy, English, chemistry, and biology; mathematics has used teachers of economics, Spanish, Greek, music; geography has employed members of the French, biology, and library science departments, and English has used teachers of music, Latin, German, and speech. This reshuffling of the departments of the College has not only developed new skills and understandings, but created a sympathy between departments which were formerly quite widely divergent. Our experience has renewed our faith in the liberal arts college as the place which is uniquely fitted for the task of integrating knowledge and unifying the college curriculum.

At the center of this integrated pattern of general and liberal education stands the individual man. He is a part of the physical world and realizes that fact first through a consciousness of his own physical well-being, or health. He is also a part of society and must adapt himself to it through the techniques of what we call manners, or conduct. He is equally a part of the realm of ideas and ideals, noting this fact first through his attitude toward himself and self-realization.

The individual stands in the area of the intersection of these three circles, and it is the function of education to enable him to adjust himself in all three directions. To achieve a satisfactory relation with the physical universe and social order, he must sharpen the tools of his perception and must therefore learn the scientific method and the principles of psychology. Although the scientific method may use a different procedure in the study of astronomy, physics, chemistry, and geology, from that which it employs in biometrics, anthropology, history, economics, and political science, these are merely refinements of a basic approach.

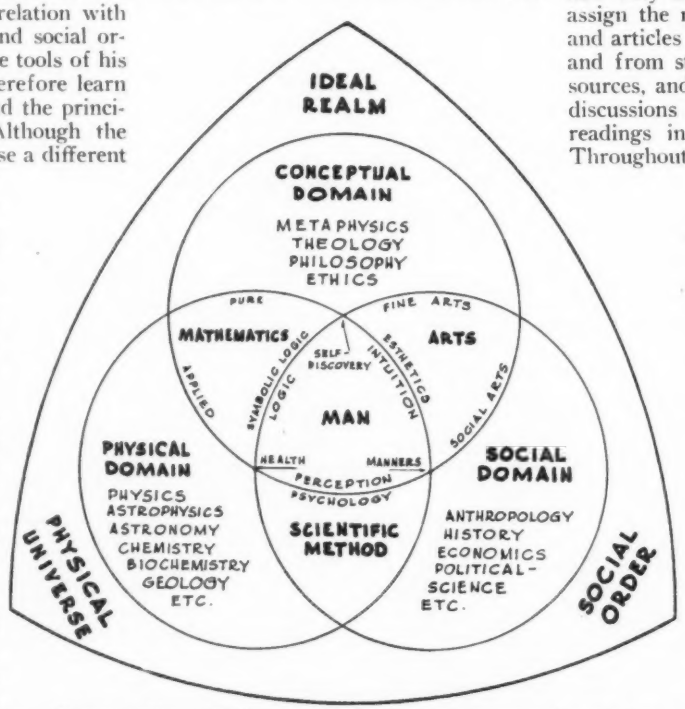
To preserve the relation between the physical universe and the realm of ideas, the individual must study logic and through logic arrive at mathematics, for mathematics, in its applied form, is the key to the physical universe and the companion of scientific method. In the realm of ideas, mathematics becomes symbolic logic and opens the doors of metaphysics and philosophy.

To achieve integration between the social order and the ideal, man must cultivate his intuition and sharpen the tool of his aesthetic appreciation, for the arts are the bridge between the two realms of society and ideas. There are, of course, the social arts of architecture and community planning, as well as the fine arts of painting, sculpture, and literature. Music, dance, and the theatre are on the borderline between social expression and the ideal. Through aesthetics and the study of the beautiful, man establishes relations with theology and ethics. It is the task of education, particularly at the college level, to insure that no individual is allowed to think himself generally educated unless he has made some earnest efforts to line himself up with these areas through the techniques suggested.

To insure this integration, the Knox faculty established a plan of tutorial instruction, beginning in the freshman year. We have several faculty members volunteering to serve as tutors, and to each of them will be assigned approximately ten freshmen. The tutor, in a series of almost daily conferences, will attempt to do many things for the students in his charge. He will help to sharpen the tools of expression and of calculation through a rapid review of English composition and mathematics, if these are needed. He will make an exhaustive inventory of what the student already knows in the three basic areas in order that he may suggest where the various gaps exist and how they should be filled. He will assign the reading of certain books and articles chosen from the classics and from stimulating contemporary sources, and will conduct suggestive discussions and analyses of these readings in tutorial conferences. Throughout it all the tutor will emphasize the interrelations between all the subjects which the student is pursuing, including the directing of the entire program of study in other courses, and guidance of a vocational nature.

Even the classroom work in languages becomes part of the plan of educational integration, for the student is not thrust immediately into a study of grammatical forms and rules, but begins instead with a discussion of the geography and culture of the people whose language he wishes to understand. Then he listens to the music of the nation, looks at its art, and reads specimens of its literature in English. During all this time he is naturally picking up a vocabulary; but the study of formal grammar comes only at the stage where it is really useful and necessary.

AN INTEGRATED PATTERN OF GENERAL AND LIBERAL EDUCATION



EDITORIAL NOTE: During the discussions of an integrated curriculum at Knox College described by President Davidson in the accompanying article, individual and collective efforts were made informally to equate some of the more conspicuous features of human nature to their results in curricular content. Some formal discussion of this relationship, between man and his works, in terms of Gestalt psychology, was stimulated by a suggestion of Dr. C. M. Hanson, Professor of Education, that studies of integration at this high level must of necessity use some such principle. The committee (Mr. Hanson, N. B. Johnson, F. R. White and F. L. Kunz) met only briefly and submitted no formal report, for it is obvious that immense and and sustained labours are required for such a task. But the above scheme of relations (in a structure suggested by Mr. White) conforms to the modest attempts of this Knox Committee to see man in his full nature, in relation to the several chief cultural fields in which that nature tends to express itself; and it puts President Davidson's reasoning in compact visual form.

Even then it is given in the form of "general language," so that what is learned in one language will be helpful for others and will react favorably on English.

After a reasonable period of the absorption of knowledge and skills to enable the individual to fit himself into his world, the College will devote the latter half of the four-year program to the implementation of this knowledge and skill in various areas of specialization for the development of individual personality and for the creation of a reasoning, resourceful, and responsible citizen.

We are, of course, interested in the implications of this kind of education for the American society of the future. We sincerely believe that it should lead to self-discipline as a counter-balance to tyrannical dictatorship. The great problem of government and industrial relationships in the new world is going to be the achievement of balance between freedom and responsibility. The test of a free man in the world of tomorrow will be whether or not he has freedom of decision in the areas of his life which are most important to him. Our education must provide him with the ability to make decisions; our government must preserve the freedom to decide.

In John Steinbeck's novel, *The Grapes of Wrath*, one of the most powerful scenes is that in which the old sharecropper gets out his shotgun to shoot the person who is driving him from his land. Those who come to dispossess him try to explain to him that he is being pushed out by no individual, but by an impersonal corporation. With a puzzled look he then asks the great question of our day: "Then who the heck am I going to shoot?" To overcome the great forces of impersonality which the corporation, the government bureau, the international cartel, and the labor union have erected in our society, education should do all in its power to restore the dignity of the individual human being. By placing this individual at the center of its curriculum, and by providing him with the tools and thoughts by which he can control his relations to his world, Knox College believes it can make a real contribution in that direction.

INSTITUTIONS CONFRONT THE TASK

A Brief Bibliography

[The comparatively extended reference to the University of Chicago is made because the integrated educational program and the integrated organization of the faculty there are the only large-scale preparations before the country avowed as preliminaries to the achievement of a common conceptual and verbal discourse. Yet even at Chicago, where a purpose has long been clear, the primary gain, the merest outline of a common conceptual pattern, has not so far to our knowledge appeared, nor any point indicated where the unravelling of curricular complex can be begun, in terms of generally acceptable concepts. —*Editor.*]

THE HARVARD REPORT: GENERAL EDUCATION IN A FREE SOCIETY, Harvard University Press, Cambridge, Massachusetts, 1945. May be regarded as a summary of the preceding years of war-time discussion among educators in America. The need for "some over-all logic" to bind together all subjects and all life is admitted as the ideal solution of present intellectual and ethical confusion. The Report ignores any but European and Western culture and achievements. Its urbane language and pleasant detachment have distracted most reviewers from seeing the gravity of the circumstances described in the Report, and reviews in general made most reference to the changes proposed in the Harvard elective and advisory system. All chief aspects of the educators' dilemma are examined, and adjustments suggested, and we are explicitly encouraged to go on looking for the "strong logic."

THE FUTURE OF EDUCATION, Porter Sargent, 11 Beacon Street, Boston, 1944. This book can be profitably read along with the Harvard Report, as it provides the cases, names, and dates required to see the urgency of reform at the conceptual source, which the Harvard Report approaches by its impartial study of dilemmas and alternatives. The author has no occasion to be impersonal, and the reader will find here a purifying forthrightness. Mr. Sargent is, so to speak, the educator's educator. He is the publisher of the standard Handbook of Private Schools and many important works on educational theory and practice, such as The Continuing Battle, and Between Two Wars, both recent.

A DESIGN FOR GENERAL EDUCATION, for members of the armed forces, American Council on Education Studies, 744 Jackson Place, Washington, D. C., 1944. This book was prepared by a special committee of the American Council to serve the U. S. Armed Forces Institute in its expanded program of instruction for the services, and affords a valuable proportional survey and reduction to small dimensions of the chief materials required in a general and liberal education. It has much more than war-time meaning. Distinguished and mature American scholars have here concentrated into outlines subject matter not elsewhere available in such compact form and firmly pointed expression. "The confusion in higher education, like the confusion of contemporary life, is due to the conflict of values and ends." p. 170.

THE REBIRTH OF LIBERAL EDUCATION, Fred B. Millet, Harcourt Brace, New York, 1945. A brief recent investigation of progress in restoring proportions in the curriculum, in six colleges and ten universities in which special efforts have been made to achieve a balance, especially where interdepartmental, basic, core and like courses have been developed to supplant superficial surveys and other forms of compromise with a situation which demands integration.

THE POST-WAR RESPONSIBILITIES OF LIBERAL EDUCATION, Association of American Colleges Bulletin, xxix (May, 1943). "It is not enough to know a good many facts in the main areas of human knowledge or to be responsive to various kinds of value. To be liberally educated is to understand these facts and these values in relation to one another." p. 286.

On Education, Sir Richard Livingstone, Cambridge University Press, New York, 1944. "Sir Richard tells us that our calamities and continuing dangers arise from our being an 'age without standards', without knowledge of the 'science of good and evil' . . .," Dr. Gildersleeve, in her Introduction. These essays put the American reader in touch with British educators' thinking, and through them with values in the Danish Folk Schools and other European reactions to the crisis caused by science and the conceptual breakdown of this century.

Liberal Education Re-Examined, Theodore M. Greene, Charles C. Fries, Henry M. Wriston, William Dighton, Harper's, 1943. The work of a committee appointed by the American Council of Learned Societies. See in this connection *The Nature of a Liberal College*, Henry M. Wriston, Lawrence College Press, Appleton, Wisconsin, 1937.

Liberal Education and the College Curriculum, C. J. Ducasse, Journal of Higher Education, Vol. xv, No. 1, January 1944. A distinguished thinker disentangles four strictly curricular basic disciplines to be practiced in liberal education: the discipline of formal thinking, of empirical investigation, of hypothesis, of appreciation, classes modified from President Wriston's list in *The Nature of a Liberal College*.

Approaches to National Unity, the Fifth Symposium of the Conference on Science, Philosophy, and Religion in Their Relation to the Democratic Way of Life, Inc. The number of approaches provided by this conference, to what is here called the complicated problem of national unity, has now risen in five years annually to fifty-nine in 1944 and sixty-four in 1945. In its third year the Conference formally announced to the press its failure to reach its initial goal of a common discourse, and no sign of such achievement is in sight. The value of the Conference is therefore not its integrative achievements but a proof that quite other techniques must be sought and applied. Efforts were made to do this in a Conference on Methods in Science and Philosophy at the New School for Social Research, New York, in 1942, and in 1943 and 1944 other like groups came into existence. These were all intermittent and some merely sporadic and indeed no sustained effort has been established free of the errors of the past. The student of American education should look into not only these Symposia of the original Conferences, but the history of these groups as recorded in The Humanist, 1201 Union Street, Schenectady, New York since the inception of such efforts in 1940.

The United Nations Educational Conference met in London in November, 1945, to project an International Educational Organization. Its reports are eaggerly awaited. The history of the International Catalogues of Scientific Literature from its start in 1905 to its breakdown in 1914 and end in 1922 shows that a good deal of unofficial effort must be made to ensure that this promising effort of today does not have a long and ineffective career in officialdom. No amount of assistance from Departments of State and of Commerce (reported to be active), can be a substitute for the personal vitality of free groups and liberal-minded individuals.

Library Research Conference Report, September, 1944 meetings. Paul Mandeville, Director, Box 685, Station A, Champaign, Illinois. Deals with the enormous task ahead in making data available, and shows how fragmentary is knowledge even in a subdepartment, compared with all that has been determined in the area, thus showing by implication a weakness in conceptual developments arising for the many lacunae in a field, gaps which have been filled in in the past and then have reappeared as the related data sank from view, so that in some cases even the expert has lost sight of the items. The comment may be made that this is less the case with physical science materials and those in particular of a useful nature. But frequently such data as are important to concepts, and not kept alive by applications in technology, are quite lost to sight.

Science as International Humanism, Sir Richard Gregory, The Humanist, Summer, 1943. "In the realm of the humanities, as in that of the natural sciences, the closer the approach of a principle to fundamental truth, the longer it will survive. All peoples of the world have certain attributes in common, and all high religions teach the observance of certain ethical principles. When these principles have been collated and analysed, a sound basis will be secured for the constitution and judgments of a court of international politics, and the goal of world unity will come into view." Quoted by Dr. Oliver L. Reiser in *The World Sensorium*, The Avalon Press, New York, 1946.

Universities Look for Unity, John Ulric Nef, Pantheon Books, Inc., 44 Washington Square, New York, 1943. A pamphlet of forty-two pages by the executive secretary of the Committee of Social Studies of the University of Chicago, who also wrote the memorandum of the Committee, from which we quote: "The problem of arranging modern knowledge according to some intelligible plan which will help the student to obtain a sense of its meaning as a whole calls for fresh consideration of the purposes of learning. That is the object of studying philosophical values. This problem also calls for the consideration of the significance for modern society of the vast stores of information made available by the last four or five generations of historians and archaeologists. Finally, this problem calls for a consideration of the meaning and value of modern analytical and theoretical studies. If these three gigantic tasks are to be faced, the scholar will have to continue, especially in connection with the last two, to make use of methods derived either directly or indirectly from the natural sciences. But he will have to do more. The relations between human beings have always been profoundly affected by the activity of their minds, which cannot be understood completely in terms of physical causes and objective data. It is necessary, therefore, to acquire more knowledge concerning the working of the mind and the spirit than the recent preoccupation of scholarship with methods derived from the natural sciences has facilitated. It is necessary to encourage scholars and students to use their rational powers in generalizing from scientific research in various branches of knowledge. In order to do this the special vocabulary and signs of particular disciplines need to be gradually translated and incorporated into a common body of concepts and propositions embracing all the disciplines and intelligible to all serious thinkers."

THE BIOSPHERE AND THE NOÖSPHERE

W. I. Vernadsky*

* The author of this article was a member of the Academy of Sciences of the U.S.S.R. His death (January 6, 1945) was a severe loss to the scientific and philosophical world. We are grateful to the Editors of *American Scientist* for kind permission to reprint from their issue of January, 1945, in its entirety this remarkable summary of the present position of mankind. In introducing the article to their readers, the editors of *American Scientist* wrote: "The following article is composed of an introductory abstract of a paper completed in 1938, and recently published in translation in the Transactions of the Connecticut Academy of Sciences (vol. 35, pp. 483-517), under the editorship of Professor G. E. Hutchinson, and a new essay, written in 1943 and translated from the Russian manuscript by Dr. George Vernadsky of Yale University. The two contributions together present the general intellectual outlook of one of the most remarkable scientific leaders of the present century.

"The translation of the quotation under the frontispiece (from a letter to Professor A. Petrunkevitch) is as follows: I look forward with great optimism. I think that we undergo not only an historical, but a planetary change as well. We live in a transition to the noösphere. Cordial greetings, W. Vernadsky.

"The table, reproduced in abstract below, that forms the main feature of the earlier paper, calls attention to many properties of living bodies that appear so elementary that they are in danger of neglect. It is an instructive experience to go through the table applying the criteria to the crystallizable viruses, the nature of which was not apparent when the earlier paper was written."

THE BIOSPHERE

LIVING matter is the totality of all organisms present on the earth at any one time. It is usually such a totality that is important, though in dealing with the effect of man on the processes of this planet, a single individual may be of importance. The living matter of the earth may be regarded as the sum of the average living matter of all the taxonomically recognizable groups. Each of these groups is said to consist of *homogeneous* living matter.

Living matter exists only in the *biosphere*. [1] This includes the whole atmospheric troposphere, the oceans, and a thin layer in the continental regions, extending down three kilometers or more. Man tends to increase the size of the biosphere.

The biosphere is distinguished as the domain of life, but also, and more fundamentally, as the region where changes due to incoming radiation can occur.

Within the biosphere, matter is markedly heterogeneous and may be distinguished as inert matter or living matter. The inert matter greatly predominates in mass or volume. There is a continual migration of atoms from the inert matter to living matter and back again. All the objects of study in the biosphere are to be regarded as the *natural bodies* of the biosphere. They may be of varying complexity, inert, living, or bio-inert as in the case of soil or lake water. The study of all phenomena has a unity, leading to the production of a body of systematized knowledge, the *corpus scientiarum*, which tends to grow like a snowball; this *corpus* includes all systematized knowledge, and is contrasted to the results of philosophy, religion, and art where truth may be revealed intuitively; the systematized history of these activities belongs to the corpus.

Two concepts have been inadequately stressed in the past: (a) Pasteur was correct in regarding the preponderance of optically active compounds as the most characteristic general property of living matter and its products; this idea is of immense importance; (b) the functions of living organisms in the energetics of the biosphere have been seriously neglected. Biogeochemical energy may be expressed in the velocity with which the biosphere could be colonized by a given species. For certain bacteria, the limiting velocity of extension of a dividing chain of cells tending to embrace the whole circumference of the earth would tend to approach the velocity of sound.

Bearing in mind these introductory principles, the difference between living matter and inert matter of the biosphere is expressed in a table, here given in condensed form. The differences in this table are not merely differences with regard to energetics and chemical properties. They also involve a fundamental difference in the spacio-temporal manifestations of living and inert matter. It is suggested that the geometry appropriate to the bodies of living organisms may be different from that appropriate to inert bodies.

I

A. Living natural bodies exist only in the biosphere and only as discrete bodies. They have never been observed to arise except from other living bodies. Their entry into the biosphere from cosmic space is hypothetical and has never been proved.

B. *Discrete inert forms are concentrated in the biosphere but are also found much deeper in the earth's crust. They are created in the biosphere, but also enter it from below in volcanic phenomena, and from cosmic space as meteorites and dust.*

II

A. Living natural bodies, in their cellular morphology, protoplasmic nature and reproductive capacity have a unity, which must be connected with their genetic connection with each other in the course of geological time.

B. *Inert natural bodies are extremely diverse and have no common structural or genetic connections.*

III

A. Chemical differences between right and left enantiomorphs characterize the state of physical space occupied by living organisms. Either left or right enantiomorphs predominate.

B. *The left and right enantiomorphs of the same chemical compounds have the same chemical properties in inert bodies. The numbers of dextral and sinistral crystals formed in an inert medium are the same.*

IV

A. New living natural bodies are born only from pre-existing ones. From time to time new generations arise differing from the preceding ones. The rise of the central nervous system has increased the geological rôle of living matter, notably since the end of the Pliocene.

B. *New inert bodies are created in the biosphere irrespective of the natural bodies that previously existed. In general the same kind of natural bodies are formed by inert processes, as were formed two billion years ago. New kinds of inert bodies appear only under the influence of living matter, notably man.*

V

A. There are no liquid or gaseous living bodies, though liquids and gases are present in the mesomorphous or solid living bodies. Spontaneous, largely self-regulated movement is characteristic of living bodies. This may be passive as in reproduction, but the effect of reproduction is for the biosphere to be colonized, by a process comparable to the expansion of a gas.

B. *Liquid and gaseous inert bodies take the form of the receptacles in which they are contained. Solid or mesomorphous inert bodies in general show no motion peculiar to the body as a whole.*

VI

A. There is a continual stream of atoms passing to and from living organisms from and into the biosphere. Within the organisms a vast and changing number of molecules are produced by processes not otherwise known in the biosphere.

B. *Inert natural bodies change only from outside causes, with the exception of radio-active materials.*

VII

A. The number of living natural bodies is quantitatively related to the size of the biosphere.

B. *The number of inert natural bodies is defined by the general properties of matter and energy, and is independent of the size of the planet.*

VIII

A. The mass of living matter has remained fairly constant, being determined by radiant solar energy and the biogeochemical energy of colonization, but apparently the mass increases towards a limit, and the process is not yet complete.

B. *The area of manifestation of inert natural bodies in the biosphere is limited by the size of the latter and increases only as the biosphere is expanded by the motion of living matter.*

IX

A. The minimum size of a living natural body is determined by respiration, and is of the order of 10^{-5} cms. The maximum size has never exceeded $n \cdot 10^{4}$. The range, 10^{10}, is not great.

B. *The minimum size of an inert natural body in the biosphere is determined by the degree of dispersion of matter and energy, i.e., the size of the ultimate particles of physics. The maximum size is determined by the size of the biosphere. The range is* 10^{20} *or more.*

X

A. The chemical composition of living bodies is a function of their own properties.

B. *The chemical composition of inert bodies is a function of the properties of the medium in which they are formed.*

XI

A. The number of kinds of chemical compounds in living bodies is connected with the kinds of individual organisms and probably reaches many millions.

B. *The number of different kinds of chemical compounds in inert bodies is limited to a few thousands.*

XII

A. The processes in living matter tend to increase the free energy of the biosphere.

B. *All inert processes, save radio-active disintegration, decrease the free energy of the biosphere.*

XIII

A. Living natural bodies are always mesomorphous, and except in latent conditions H and O as water predominate, with an extremely complicated mixture of other compounds. The chemical composition of any one kind of living matter, though not exhibiting stoichiometric relationships, is definitely determined and more constant than the isomorphous mixtures constituting natural minerals.

B. *The chemical composition of inert natural bodies may correspond to nearly pure chemical compounds with precise stoichiometric relations between the elements. In minerals solid solutions predominate.*

XIV

A. Isotopic ratios may be markedly changed by the processes in living matter.

B. *The isotopic ratios do not change markedly in the inert natural bodies of the biosphere, though outside the biosphere, deep in the crust, such changes may occur.*

XV

A. The vast majority of living natural bodies change their forms in the process of evolution. The rates at which these changes occur are, however, widely divergent.

B. *The majority of the inert bodies of the biosphere are stable, and so lack variety.*

XVI

A. The processes of living natural bodies are not reversible in time.

B. *All physiochemical processes in inert natural bodies are reversible in time.*

In everyday life one used to speak of man as an individual, living and moving freely about our planet, freely building up his history. Until recently the historians and the students of the humanities, and to a certain extent even the biologists, consciously failed to reckon with the natural laws of the biosphere, the only terrestrial envelope where life can exist. Basically man cannot be separated from it; it is only now that this indissolubility begins to appear clearly and in precise terms before us. He is geologically connected with its material and energetic structure. Actually no living organism exists on earth in a state of freedom[2]. All organisms are connected indissolubly and uninterruptedly, first of all through nutrition and respiration, with the circumambient material and energetic medium. Outside it they cannot exist in a natural condition.

In our century the biosphere has acquired an entirely new meaning; it is being revealed as a planetary phenomenon of cosmic character. In biogeochemistry we have to reckon with the fact that living organisms actually exist not on our planet alone, and not in the terrestrial biosphere only. It seems to me that so far this has been established beyond doubt only for all so-called "terrestrial planets," that is, for Venus, the Earth, and Mars[3].

The thought of life as a cosmic phenomenon was alive long ago, as evidenced by the archives of science, including Russian science. At the end of the seventeenth century, the Dutch scientist Christian Huygens (1629-1695) put forward that problem in his last work, "Cosmotheoros," which was published after his death. This book, upon the initiative of Peter the Great, was twice published in Russian in the first quarter of the eighteenth century, under the title, "The Book of Contemplation of the World" [4]. In it Huygens established the scientific generalization that "life is a cosmic phenomenon somehow sharply distinct from inert matter." I have recently called this generalization the "Huygens principle" [5].

Living matter, by weight, constitutes an insignificant part of our planet. Presumably, this is observed in the whole course of geological time; in other words, this relation is *geologically eternal* [6]. Living matter is concentrated in a thin but more or less continuous film on the surface of land in the troposphere, in the forests and fields, and permeates the whole ocean. Its quantity is calculated to be of the order of 0.25 per cent of the weight of the biosphere. On land it descends under the surface in non-continuous accumulations, probably down to an average depth of less than 3 kilometers.

THE NOÖSPHERE [7]

We are approaching the climax in the Second World War. In Europe war was resumed in 1939 after an intermission of twenty-one years; it has lasted five years in Western Europe, and is in its third year in our parts, in Eastern Europe. As for the Far East, the war was resumed there much earlier, in 1931, and is already in its twelfth year. A war of such power, duration and strength is a phenomenon unparalleled in the history of mankind and of the biosphere at large. Moreover, it was preceded by the First World War which, although of lesser power, has a causal connection with the present war.

In our country that First World War resulted in a new, historically unprecedented, form of statehood, not only in the realm of economics, but likewise in that of the aspirations of nationalities. From the point of view of the naturalist (and, I think, likewise from that of the historian) an historical phenomenon of such power may and should be examined as a part of a single great terrestrial *geological* process, and not merely as a *historical* process.

In my own scientific work the First World War was reflected in a most decisive way. It radically changed my *geological conception of the world*. It is in the at-

mosphere of that war that I have approached a conception of nature, at that time forgotten and thus new for myself and for others, a geochemical and biogeochemical conception embracing both inert and living nature from the same point of view [8]. I spent the years of the First World War in my uninterrupted scientific creative work, which I have so far continued steadily in the same direction.

Twenty-eight years ago, in 1915, a "Commission for the Study of the Productive Forces" of our country, the so-called KEPS, was formed at the Academy of Sciences. That commission, of which I was elected president, played a noticeable role in the critical period of the First World War. Entirely unexpectedly, in the midst of the war, it became clear to the Academy of Sciences that in Tsarist Russia there were no precise data concerning the now so-called strategic raw materials, and we had to collect and digest dispersed data rapidly to make up for the lacunae in our knowledge [9]. Unfortunately by the time of the beginning of the Second World War, only the most bureaucratic part of that commission, the so-called Council of the Productive Forces, was preserved, and it became necessary to restore its other parts in a hurry.

By approaching the study of geological phenomena from a geochemical and biogeochemical point of view, we may comprehend the whole of the circumambient nature in the same atomic aspect. Unconsciously such an approach coincides for me with what characterizes the science of the twentieth century and distinguishes it from that of past centuries. *The twentieth century is the century of scientific atomism.*

At that time, in 1917-1918, I happened to be, entirely by chance, in the Ukraine [10], and was unable to return to Petrograd until 1921. During all those years, wherever I resided, my thoughts were directed toward the geochemical and biogeochemical manifestations in the circumambient nature, the biosphere. While observing them, I simultaneously directed both my reading and my reflection toward this subject in an intensive and systematic way. I expounded the conclusions arrived at gradually, as they were formed, through lectures and reports delivered in whatever city I happened to stay, in Ialta, Poltava, Kiev, Simferopol, Novorossiisk, Rostov, and so on. Besides, in almost every city I stayed, I used to read everything available in regard to the problem in its broadest sense. I left aside as much as I could all philosophical aspirations and tried to rest only on firmly established scientific and empiric facts and generalizations, occasionally allowing myself to resort to working scientific hypotheses. Instead of the concept of "life," I introduced that of "living matter," which now seems to be firmly established in science. "Living matter" is the totality of living organisms. It is but a scientific empirical generalization of empirically indisputable facts known to all, observable easily and with precision. The concept of "life" always steps outside the boundaries of the concept of "living matter"; it enters the realm of philosophy, folklore, religion, and the arts. All that is left outside the notion of "living matter."

In the course of geological time living matter morphologically changes according to the laws of nature. The history of living matter expresses itself as a slow modification of the forms of living organisms which genetically are uninterruptedly connected among themselves from generation to generation. This idea had been rising in scientific research through the ages, until, in 1859, it received a solid foundation in the great achievements of Charles Darwin (1809-1882) and Wallace (1822-1913). It was cast in the doctrine of the evolution of species of plants and animals, including man. The evolutionary process is a characteristic only of living matter. There are no manifestations of it in the inert matter of our planet. In the cryptozoic era the same minerals and rocks were being formed which are being formed now [11]. The only exceptions are the bio-inert natural bodies connected in one way or another with living matter [12].

The change in the morphological structure of living matter observed in the process of evolution unavoidably leads to a change in its chemical composition [13].

While the quantity of living matter is negligible in relation to the inert and bio-inert mass of the biosphere, the biogenic rocks constitute a large part of its mass, and go far beyond the boundaries of the biosphere. Subject to the phenomena of metamorphism, they are converted, losing all traces of life, into the granitic envelope, and are no longer part of the biosphere. The granitic enevlope of the earth is the area of former biospheres [14]. In Lamarck's book "Hydrogéologie" (1802), containing many remarkable ideas, living matter, as I understand it, was revealed as the creator of the main rocks of our planet. Lamarck never accepted Lavoisier's (1743-1794) discovery. But that other great chemist, J. B. Dumas (1800-1884), Lamarck's younger contemporary, who did accept Lavoisier's discovery, and who intensively studied the chemistry of living matter, likewise adhered for a long time to the notion of the quantitative importance of living matter in the structure of the rocks of the biosphere.

The younger contemporaries of Darwin, J. D. Dana (1813-1895) and J. Le Conte (1823-1901), both great American geologists (and Dana a mineralogist and biologist as well) expounded, even prior to 1859, the empirical generalization that *the evolution of living matter is proceeding in a definite direction.* This phenomenon was called by Dana "cephalization," and by Le Conte the "psychozoic era." Dana, like Darwin, adopted this idea at the time of his journey around the world, which he started in 1838, two years after Darwin's return to London, and which lasted until 1842 [15].

Empiric notions of a definite direction of the evolutionary process, without, however, any attempt theoretically to ground them, go deeper into the eighteenth century. Buffon (1707-1788) spoke of the "realm of man," because of the geological importance of man. The idea of evolution was alien to him. It was likewise alien to Agassiz (1807-1873), who introduced the idea of the glacial period into science. Agassiz lived in a period of an impetuous blossoming of geology. He admitted that geologically the realm of man had come, but, because of his theological tenets, opposed the theory of evolution. Le Conte points out that Dana, formerly having a point of view close to that of Agassiz, in the last years of his life accepted the idea of evolution in its then usual Darwinian interpretation [16]. The difference between Le Conte's "psychozoic era" and Dana's "cephalization" thus disappeared. It is to be regretted that, especially in our country, this important empirical generalization still remains outside the horizon of our biologists.

The soundness of Dana's principle, which happens to be outside the horizon of our palaeontologists, may easily be verified by anyone willing to do so on the basis of any modern treatise on palaeontology. The principle not only embraces the whole animal kingdom, but likewise reveals itself clearly in individual types of animals.

Dana pointed out that in the course of geological time, at least two billion years and probably much more, there occurs an irregular process of growth and perfection of the central nervous system, beginning with the crustacea (whose study Dana used to establish his principle), the molluscs (cephalopoda), and ending with man. It is this phenomenon that he called cephalization. The brain, which has once achieved a certain level in the process of evolution, is not subject to retrogression, but only can progress further.

Proceeding from the notion of the geological rôle of man, the geologist A. P. Pavlov (1854-1929) in the last years of his life used to speak of the *anthropogenic era* in which we now live. While he did not take into the account the possibility of the destruction of spiritual and material values we now witness in the barbaric invasion of the Germans and their allies, slightly more than ten years after his death, he rightly emphasized that man, under our very eyes, is becoming a mighty and ever-growing geological force. This geological force was formed quite imperceptibly over a long period of time. A change in man's position on our planet (his material position first of all) coincided with it. In the twentieth century, man, for the first time in the history of the earth, knew and embraced the whole biosphere, completed the geographic map of the planet Earth, and colonized its whole surface. *Mankind became a sitgle totality in the life of the earth.* There is no spot on earth where man can not live if he so desires. Our people's sojourn on the floating ice of the North Pole in 1937-1938 has proved this clearly. At the same time, owing to the mighty techniques and successes of scientific thought, radio and television, man is able to speak instantly to anyone he wishes at any point on our planet. Transportation by air has reached a speed of several hundred kilometers per hour, and has not reached its maximum. All this is the result of "cephalization," the growth of man's brain and the work directed by his brain.

The economist, L. Brentano, illuminated the planetary significance of this phenomenon with the following striking computation: if a square meter was assigned to each man, and if all men were put close to one another, they would not occupy the area of even the small Lake of Constance between the borders of Bavaria and Switzerland. The remainder of the earth's surface would remain empty of man. Thus the whole of mankind put together represents an insignificant mass of the planet's matter. Its strength is derived not from its matter, but from its brain. If man understands this, and does not use his brain and his work for self-destruction, an immense future is open before him in the geological history of the biosphere.

The geological evolutionary process shows the biological unity and equality of all men, *Homo sapiens* and his ancestors, *Sinanthropus* and others; their progeny in the mixed white, red, yellow, and black races evolves ceaselessly in innumerable generations [17]. This is a *law of nature.* In a historical contest, as for instance in a war of such magnitude as the present one, he finally wins who follows that law. One cannot oppose with impunity the principle of the unity of all men as a law of nature. I use here the phrase "law of nature" as this term is used more and more in the physical and chemical sciences, in the sense of an empirical generalization established with precision.

The historical process is being radically changed under our very eyes. For the first time in the history of mankind the interests of the masses on the one hand, and the free thought of individuals on the other, determine the course of life of mankind and provide standards for men's ideas of justice. Mankind taken as a whole is becoming a mighty geological force. There arises the problem of the *reconstruction of the biosphere in the interests of freely thinking humanity as a single totality.* This new state of the biosphere, which we approach without our noticing it, is the *noösphere.*

In my lecture at the Sorbonne in Paris in 1922-23, I accepted *biochemical phenomena* as the basis of the biosphere. The contents of part of these lectures were published in my book, "Studies in Geochemistry," which appeared first in French, in 1924, and then in a Russian translation, in 1927 [18]. The French mathematician Le Roy, a Bergsonian philosopher, accepted the biogeochemical foundation of the biosphere as a starting point, and in his lectures at the Collège de France in Paris, introduced in 1927 the concept of the noösphere as the stage through which the biosphere is now passing geolically [19]. He emphasized that he arrived at such a notion in collaboration with his friend Teilhard de Chardin, a great geologist and palaeontologist, now working in China.

The noösphere is a new geological phenomenon on our planet. In it for the first time man becomes a *large-scale geological force.* He can and must rebuild the province of his life by his work and thought, rebuild it radically in comparison with the past. Wider and wider creative possibilities open before him. It may be that the generation of our grandchildren will approach their blossoming.

Here a new riddle has arisen before us. *Thought is not a form of energy.* How then can it change material processes? That question has not as yet been solved. As far as I know, it was first posed by an American scientist born in Lvov, the mathematician and biophysicist Alfred Lotka [20]. But he was unable to solve it. As Goethe (1740-1832), not only a great poet but a great scientist as well, once rightly remarked, in science we only can know *how* something occurred, but we cannot know *why* it occurred.

As for the coming of the noösphere, we see around us at every step the empirical results of that "incomprehensible" process. That mineralogical rarity, native iron, is now being produced by the billions of tons. Native aluminum, which never before existed on our planet, is now produced in any quantity. The same is true with regard to the countless number of artificial chemical combinations (biogenic "cultural" minerals) newly created on our planet. The number of such artificial minerals is constantly increasing. All of the *strategic raw materials* belong here. Chemically, the face of our planet, the biosphere, is being sharply changed by man, consciously, and even more so, unconsciously. The aerial envelope of the land as well as all its natural waters are changed both physically and chemically by man. In the twentieth century, as a result of the growth of human civilization, the seas and the parts of the oceans closest to shore become changed more and more markedly. Man now must take more and more measures to preserve for future generations the wealth of the seas which so far have belonged to nobody. Besides this, new species and races of animals and plants are being created by man. Fairy tale dreams appear possible in the future: man is striving to emerge beyond the boundaries of his planet into cosmic space. And he probably will do so.

At present we cannot afford not to realize that, in the great historical tragedy through which we live, we have elementally chosen the right path leading into the noösphere. I say elementally, as the whole history of mankind is proceeding in this direction. The historians and political leaders only begin to approach a comprehension of the phenomena of nature from this point of view. The approach of Winston Churchill (1932) to the problem, from the angle of a historian and political leader, is very interesting [21].

The noösphere is the last of many stages in the evolution of the biosphere in geological history. The course of this evolution only begins to become clear to us through a study of some of the aspects of the biosphere's geological past. Let me cite a few examples. Five hundred million years ago, in the Cambrian geological era, skeletal formations of animals, rich in calcium, appeared for the first time in the biosphere; those of plants appeared over two billion years ago. That calcium function of living matter, now powerfully developed, was one of the most important evolutionary factors in the geological change of the biosphere [22]. A no less important change in the biosphere occurred from seventy to one hundred and ten million years ago at the time of the Cretaceous system, and especially during the Tertiary. It was in this epoch that our green forests, which we cherish so much, were formed for the first time. This is another great evolutionary stadium, analogous to the noösphere. It was probably in these forests that man appeared, around fifteen or twenty million years ago.

Now we live in the period of a new geological evolutionary change in the biosphere. We are entering the noösphere. This new elemental geological process is taking place at a stormy time in the epoch of a destructive world war. But the important fact is that our democratic ideals are in tune with the elemental geological processes, with the laws of nature, and with the noösphere. Therefore we may face the future with confidence. It is in our hands. We will not let it go.

Borovoe, July 22/Moscow, December 15, 1943.

NOTES AND REFERENCES

1. The concept of "biosphere," that is, of the "area of life," was introduced into biology by Lamarck (1744-1829) in Paris in the early nineteenth century, and into geology by Suess (1831-1914) in Vienna at the close of the same century. On the biosphere, see W. Vernadsky, *Ochrki geokhimii*, 4th edition, Moscow-Leningrad. Index; *Biosfera* (The Biosphere) Leningrad, 1926; French edition, Paris, 1929.

2. That remarkable scientist, Caspar Wolf (1733-1794), a member of the St. Petersburg Academy of Sciences, who though not a Russian by birth, dedicated his whole life to Russia, clearly expressed the connection between organisms and their medium in a book published in German in St. Petersburg in 1789, the year of the great French Revolution, under the title, *Von d. eigenthüml. Kraft d. Vegetabl. sowohl auch d. animal. Substanz als Erläuterung zu zwei Preisschriften über d. Nutritonskraft* (On the Specific and Active Force Proper to the Vegetal and Animal Substance). Unlike the great majority of the biologists in his time, he tended toward the ideas of Newton rather than those of Descartes.
   It is to be regretted that the manuscripts left after Wolf's death have been, as yet, neither studied nor published. In 1927 the Commission on the History of Knowledge at the Academy of Sciences decided to do this work, but it could not be accomplished because of the constant changes in the Academy's approach toward the study of the history of science. Now that work at the Academy has been reduced to a minimum, which is harmful to the cause.

3. See my article on *The Geological Envelopes of the Earth as a Planet*, Izvestia of the Academy of Sciences, Geographical and Geophysical Series, 1942, p. 251. Cf. H. Spenser Jones, *Life on Other Worlds*, New York, 1940; R. Wildt in Proc. Amer. Philos. Soc. 81 (1939), p. 135. A Russian translation of Wildt's study, regrettably not in full (which is not indicated in the paper) appeared in the Astronomicheskii Zhurnal, vol. XVII (1940), no. 5, p. 81ff. By now, a new study by Wildt has appeared, *Geochemistry and the Atmosphere of Planets* (1941), but, to our regret, no copy of it has so far reached us.
   The Biogeochemical Laboratory of the Academy of Sciences in Moscow, now renamed the Laboratory of Geochemical Problems, in cooperation with the Institute of Microbiology of the same Academy (corresponding member, B. L. Isachenko) set the problem of cosmic life as a current scientific problem as early as 1940. This work was stopped by the war, but will be resumed at the first opportunity.

4. It would deserve a new edition in modern Russian, with commentaries.

5. See *Ocherki geokhimii*, pp. 9, 288, and my book *Problemy biogeokhimii* (The Problems of Biogeochemistry) III (in press).

6. *Problemy Biogeokhimii*, III.

7. The word "noösphere" is composed from the Greek terms *nous*, mind, and *sphere*, the last used in the sense of an envelope of the earth, I treat the problem of the noösphere in more detail in the third part of my book, now being prepared for publication, on *The Chemical Structure of the Biosphere of the Earth as a Planet, and its Surroundings.*

8. It should be noted that in this connection I came upon the forgotten thoughts of that original Bavarian chemist, C. Schoenbein (1799-1868) and of his friend, the English physicist of genius, M. Faraday (1791-1867). As early as the beginning of the eighteen-forties, Schoenbein attempted to prove that a new division should be created in geology—geochemistry, as he called it. See W. Vernadsky, *Ocherki geokhimii* (Studies in Geochemistry), 4th edition, Moscow-Leningrad, 1934, pp. 14, 290.

9. On the significance of KEPS see A. E. Fersman. *Voina i strategicheskoe syrie* (The War and Strategic Raw Materials). Krasnoufimsk, 1941, p. 48.

10. See my article, *Out of my Recollections: The First Year of the Ukrainian Academy of Sciences*, to appear in the Jubilee volume of the Ukrainian Academy of Sciences, in commemoration of its twenty-fifth anniversary.

11. In accordance with modern American geologists as, for example, Charles Schuchert (Schuchert and Dunbar, *A Textbook of Geology*, II, New York, 1941, p. 88ff.), I call the Cryptozoic era that period which formerly had been called the Azoic, or the Archaeozoic, era. In the Cryptozoic era the morphological preservation of the remnants of organisms dwindles almost to nothing, but the existence of life is revealed in the organogenic rocks, the origins of which arouse no doubts.

12. On the bio-inert bodies see W. I. Vernadsky, *Problems of Biogeochemistry, II*. Trans. Conn. Acad. Arts Sci., vol. 35 (1944), pp. 493-494. Such are, for example, the soil, the ocean, the overwhelming majority of terrestrial waters, the troposphere, and so on.

13. This problem urgently needs experimental verification. It has been set forth by the Laboratory of Geochemical Problems in collaboration with the Palaeontological Institute of the Academy of Sciences, in the plan of our work for 1944.

14. See my basic work referred to in Note 7.

15. One should not fail to note here that the expedition during which Dana came to his conclusions concerning cephalization, the coral islands, and so on, actually and historically was closely connected with the exploration of the Pacific by Russian navigators, especially Krusenstern (1770-1846). See D. Gilman, *The Life of J. D. Dana*, New York, 1899. The chapter on the oceanic expedition in this book was written by Le Conte. Le Conte's book, *Evolution* (1888), has not been accessible to me. His autobiography was published in 1903: W. Armes, Editor, *The Autobiography of Joseph Le Conte*. For his biography and bibliography see H. Fairchild in Bull. Geol. Soc. Amer. 26 (1915), p. 53. It was the report on the Russian travels, published in German in 1827, which spurred the American lawyer, John Reynolds, to insist on the organization of a similar American scientific oceanic expedition. Owing to Reynolds' persistence, the expedition eventually materialized, but not until eleven years afterwards, in 1838. This was the Wilkes expedition, which finally proved the existence of the Antarctic.
   On Reynolds see the Index in *Centenary Celebration: Wilkes Exploring Expedition of the U. S. Navy, 1838-1842*, Proc. Amer. Philos. Soc., 82, No. 5 (1940). It is to be regretted that our expeditions in the Pacific, so active in the first half of the nineteenth century, were later discontinued for a long time (almost until the Revolution), following the death of both Emperor Alexander I (1777-1825) and Count N. P. Rumiantsov (1754-1826)—that remarkable leader of Russian culture who equipped the "Riurik" expedition (1815-1818) out of his private funds.
   In the Soviet period K. M. Deriugin's (1878-1936) expedition should be mentioned; its precious and scientifically important materials have been so far only partly studied and remain unpublished. Such an attitude toward scientific work is inadmissible. The Zoological Museum of the Academy of Sciences must fulfill this scientific and civic duty.

16. D. Gilman, *o.c*, p. 255.

17. I and my contemporaries have imperceptibly lived through a drastic change in the comprehension of the circumambient world. In the time of my youth it seemed both to me and to others that man had lived through a historical time only, within the span of a few thousand years, at best a few tens of thousand of years. Now we know that man has been consciously living through tens of millions of years. He consciously lived through the glacial period in both Eurasia and North America, through the formation of Eastern Himalaya, and so on. The division of historical and geological time is leveled out for us.

18. The last revised edition of my *Ocherki Geokhimii* (Problems of Geochemistry) appeared in 1934. In 1926 the Russian edition of *Biosfera* (The Biosphere) came out, and in 1929 its French edition. My *Biogeokhimicheskie Ocherki* (Biogeochemical Studies) was published in 1940. The publication of *Problemy biogeokhimii* (Problems of Biogeochemistry) was begun in 1940. (A condensed English translation of Part II appeared, under the editorship of G. E. Hutchinson, in Trans. Conn. Acad. Arts Sci., vol. 35, in 1944.) Part III is in press. *Ocherki geokhimii* was translated into German and Japanese.

19. Le Roy's lectures were at once published in French: *L'exigence idéaliste et le fait d'évolution*, Paris, 1927, p. 196.

20. A. Lotka, *Elements of Physical Biology*, Baltimore, 1925, p. 405 f.

21. W. S. Churchill, *Amid These Storms: Thoughts and Adventures*, New York, 1932, p. 274 f. I plan to return to this problem elsewhere.

22. I deal with the problem of the biogeochemical functions of organisms in the second part of my book, *The Chemical Structure of the Biosphere* (see Note 7).

ON RELATIVITY

Albert Einstein to Alfred Stern

The following is from an article by Alfred Stern in *Contemporary Jewish Record*, June, 1945, reporting an interview with Albert Einstein. Our source journal is now called *Commentary*, address 425 Fifth Avenue, New York 16. It is conducted under the auspices of a distinguished editorial board. We are grateful for their generous permission to print.

For the benefit of those to whom the subject under discussion herein is unfamiliar a note may be useful. An object of the physical studies of the theoretical physicists is, among other, to bring off a unified theory of all studies of matter and energy. This magnificent enterprise involves so-called pure philosophical subjects, but does not touch the unique features of life and self-consciousness. Furthermore, the reduction is to mathematical form and therefore, in the opinion of many, denuded of values useful to society. The long-range use to mankind is, however, of incalculable benefit.

The mathematics at present employed in the endeavor to bring together gravitational and electromagnetic phenomena of all kinds is called Riemannian, and contains a line-element, hence it is not a reduction to the lowest possible element, the point. It contains, as a natural feature of its discourse, a provision that a highest possible velocity must exist, and this velocity will not be infinite, but finite even if high. In relativity light has been taken as having this velocity. The mathematics in question is a four-dimensional geometry, and time is taken (in a certain sense) as the fourth dimension. Within this framework the unification sought has not been found, as the following passages indicate. The geometry employed, at present, has been (so to speak) exhausted of its chief features. Hence Eddington's attempt at a purely topological point-event system, interest in a fifth dimension, and other approaches to the problems unresolved. F.L.K.

"IN ANSWER to my question as to the present state of the theory of relativity, its creator revealed the following:

" 'The general theory of relativity, as it has existed up to now, is not the last word in theoretical physics. Certainly what will remain as definitely established is that there is no absolute movement and this must be expressed in physical laws. But the specific way in which the general theory of relativity described the properties of space is provisional and not destined for eternity.

" 'The theory of relativity, as I developed it originally, still does not explain atomism and the quanta phenomena. And neither does it include a common mathematical formulation covering the phenomena of both the electro-magnetic and the gravitational fields. This demonstrates that the original form of the theory is not definitive. Its basis indeed is unshakable, but its means of expression are in process of evolution. It is to this evolution and to the amplification of the theory of relativity that I am now devoting my efforts.'

"Speaking of the logical operations of this work, Professor Einstein said:

" 'In the verification of a theory the most difficult task is always the necessity of developing its consequences to a point where they become empirically controllable. The distance between the foundation and the controllable consequences becomes greater and greater. The task to which I am now giving my greatest efforts is to resolve the dualism between the theories of gravitation and electro-magnetism, and to reduce them both to one and the same mathematical form.'

"Our conversation touched on the crisis in 'causality' that physics is now going through, thanks to Heisenberg's sensational 'relations of uncertainty.' At this point I reminded Einstein that it was his own theory of 'photons' or luminous quanta that brought Heisenberg to his relations of uncertainty.

" 'That is quite so,' said Einstein. 'However I would prefer not to speak of a 'theory' of photons. It wasn't a theory. It was a simple discovery which led me to consider light as composed not only of waves but also of corpuscles called photons. Thus it became necessary to take account of the fact that light was of atomic structure and had weight.'

"As we know, the physicist Heisenberg concluded that all measurement of a micro-corpuscle must be imprecise, for in being measured it is subjected to the influence of photons, which by striking it modify its position and its speed—that is, its energy at the moment. Whence the impossibility of knowing with precision the present state of the world. One cannot predict its future states. From that Heisenberg deduced the 'invalidity of the law of causality,' replacing classic determinism with probabilism.

"To my question as to his attitude toward this radical negation, Einstein replied:

" 'We must distinguish between causality as a postulate directed towards theory and causality as a postulate towards the observable. This last demand remains unsatisfied—empirical causality does not exist—and it may well remain so. I believe it is too narrow a formulation to consider causality as necessarily a temporal sequence between the present and the future. That is only one form of the causal law—but not the only one. According to the general theory of relativity, time loses its independence and becomes only a single coördinate of a four-dimensional system called the *world*. In the four-dimensional world causality will be only a link between two breaks. This constitutes causality as it corresponds to the general theory of relativity.'

"I recalled to Einstein that Heisenberg had rejected the notion that behind the observable, statistical world a real world ruled by causality is hidden. 'Physics,' wrote Heisenberg, 'is only called upon to describe the coherence of perceptions in a formal manner. It being assumed that all experiments are subject to the laws of quantum mechanics, the invalidity of the law of causality is definitely established.'

"To this Professor Einstein said the following:

" 'The quantum theory is without doubt a fruitful doctrine, but it does not reach to the bottom of things. I have never believed that it constitutes the true conception of nature. I believe that one can describe nature and that its laws do not relate solely to possibilities and their changes, but to the temporal changes of an entity. I am not a positivist. I believe that the exterior real world constitutes a foundation which we could not give up. Positivism states that what cannot be observed does not exist. But this conception is scientifically indefensible, for it is impossible to make valid affirmations concerning what people 'can' or 'can not' observe. It would be necessary to say: only what we observe exists. But that is obviously false too, because the observable world does not exist. What we observe is not the world.'

" 'The quantum theory . . . ceases to regard physical laws as laws of being, and limits itself to relating these laws to some possibilities of being. When the probabilities in a system are given, it calculates the probabilities for another value of time; thus all physical laws are related, according to the quantum theory, to probabilities and not to an objective entity.'

" 'However I believe . . . that we need a conceptual world to convert our sensations into something utilizable for thought. It is an illusion to think that we perceive the world. When we say that we perceive the world we have already transformed our sensations—by a primitive theory—into something conceptual. What our senses give us can only become a conception of the world through a conceptual construction. One cannot affirm therefore that no world exists behind the observable world, for this observable world does not exist—that is, it is not given to us by our senses'."

THERMODYNAMICS IN BIOLOGY

Herbert E. Salzer

INTRODUCTORY NOTE ON THE PHASE RULE: One of the simplest and most widely used laws of science is the Phase Rule which was deduced some seventy years ago by that great American scientist, Josiah Willard Gibbs. It made its appearance in that celebrated memoir entitled *On the Equilibrium of Heterogeneous Substances,* and only after a number of years was it found to play a key role in the interpretation of all sorts of equilibrium, both chemical and physical, such as between solids and vapors, solutions, alloys, various chemical mixtures in science and technology, minerals, ores, etc.

The phase rule states that for any set of materials in equilibrium, i.e., a system, the number of degrees of freedom (F) is equal to the number of independent components (C) increased by two and diminished by the number of phases (P) or, $F = C + 2 - P$. Now, by a phase of a particular substance we mean any homogeneous state, such as a solid, liquid, or gas, irrespective of shape or size. Thus water and ice would be a system of two phases, a liquid and solid. By components we mean the actually different types of substances in the system, capable of existing independently of each other, regardless of the states in which they are found. Thus the above system has only one component, water, whereas if we had a solution of salt-water enclosed with its vapor, we would have two components, the salt-water (liquid phase), and pure water (vapor phase). By number of degrees of freedom we mean how many conditions, such as temperature, pressure, concentration (for mixtures) can be varied while still preserving the system with its phases and components. For example, the water and its vapor can exist together at any temperature, (but that determines the pressure of the system) so that such a system has one degree of freedom. Water, ice and its vapor can exist together for only one pair of values of the temperature and pressure; hence that system possesses no degree of freedom.

The purpose of the following article is to raise the question of extending the notion of "phase" to other than simple inanimate entities, as solids, liquids or gases.

The student of the relation of the living and the so-called non-living is recommended to read in this connection an important brief work by the physicist, Erwin Schrödinger: *What is Life? The Physical Aspect of the Living Cell,* Macmillan, N. Y., 1945, 91 pages.

THE PHASE RULE makes no restriction on the size of the particles composing the phase. Thus, any homogeneous phase if sufficiently magnified would appear unhomogeneous but made up of a large aggregate of *similar* entities. Then, why may we not go the other way and say that any aggregate of *similar* (identical in every respect) entities, if sufficiently large, may constitute a homogeneous system or a phase? Two or more are in equilibrium if there *is* no tendency toward spontaneous alteration in the quantity or existence of any. Independent components will be defined as usual. If the phase rule still holds: $(F = C + 2 - P)$ it is possible that we may extend to cases where the phases are not necessarily composed of molecular units, or are necessarily inorganic. However this is in the highest degree hypothetical; the derivation of the phase rule may tacitly negate such possibilities, but there is no harm in seeing to what necessary conclusions its extension into physiology may bring us. Of course if it leads to conclusions contrary to fact, it is just too bad for the generalization, and nothing more remains to be said.

Let us try systems of living cells in dynamic equilibrium. Naturally, this would exclude any case of growth or pathology or any place not in equilibrium. If it can be demonstrated that no such thing as true equilibrium in the chemical sense of the word exists in living things, then the phase rule cannot be applied, since it is fundamentally based on equilibrium, and we have no general law yet, analogous to D'Alembert's principle in dynamics, to reduce the problem to one of statics.

The question arises: Are different cells different phases or components? Cells all of one tissue (continuous) which appear alike, will constitute one phase ot one component. But in actual living things we have many kinds of cells coëxisting. They may be possibly thought of in two ways: (1) as different phases of the same component, (2) as different components.

For (1) we may think of all cells essentially the same chemically, and differences between tissues in the same light as the difference between ice and water or rhombic and monoclinic sulphur. For (2) we may think of all different cells (of same individual of course) as being different components as well as different phases. The question will not be easy to decide, for cells of tissues do differ chemically if they are not of the same tissue or are diseased, but the chemical differences, according to view (1) are slight compared with all the ways in which they are alike, just as the differences between rhombic and monoclinic sulphur are insignificant compared with their resemblances, so we call them different phases of the same substances. Both (1) and (2) are each evidently untenable hypotheses to make singly and if the phase rule works here (which is doubtful) the chances are that whether we consider an assemblage of tissues as consisting of different phases of the same substance or different substances will be to a large extent arbitrary and prejudiced by how the matter will work out.

Embryology is no help to decide which tissues are to be regarded as different substances from each other, since *cells are not elements* and one kind can be often formed from another. Undifferentiated embryonal mesenchyme, evidently a "homogeneous phase" to start with, gives rise to all sorts of different tissues, as bone, nerve, muscle, etc. But the objection will be raised, that this apparent shift in equilibrium is produced by the ingestion of food, which is the addition of another phase. Will mesenchyme differentiate itself spontaneously without food, i.e. consume itself, and in so doing produce different tissues to a lesser degree? There are

cells like those containing almost 100% fat, the same substance as bone cells. Hundreds of puzzling examples could be produced to show all the difficulties in glibly transferring this rule to a system as complex as an organism. Anyway, nothing like trying! We shall try out different hypotheses as to what are the components and what are the phases and when we have an "allotropic form" of the essentially same cell and when we think we have 2 different substances. The absence of any stable and intransmutable unit like the element makes for this difficulty. What are the variables? Since we still use Temperature and Pressure in chemistry, whether we have sulphur or 2.4 dibromacetanilid, we might still try temperature and pressure. The former is easy enough to apply; it is interesting to note that we shall have the convenience, in the case of many living systems, of dealing with entities at constant temperature throughout. (Notice how some creatures must have a certain constant temperature—with little variation—in order to live, while other creatures are capable of enormous variation in temperature.) The latter, if we pursue our analogies far enough, are systems with one degree of freedom, while the former represent an invariant system since changing one of the variables (T) upsets the equilibrium. Then we do not know that the temperature is the same throughout. In the cases that we might take up, the temperature will of necessity be constant throughout the system.

Pressure is a harder thing to define. It cannot be the pressure of the atmosphere. Then we have to consider the effects of gravity (great in a case of a tree) capillarity (also great for plants) electrical forces, etc. It certainly is difficult to conceive of a complex living thing, with the same pressure at every cell. Is there such a thing as an internal constant pressure in a group of tissues? Is blood pressure equal to the pressure that we are seeking, or is pressure a vague and inconstant thing? The chances are that the simpler and smaller the tissues, the better chance that there is for uniform pressure.

Another question will arise. Suppose starting out with a group of cells, certain ones change and become pathological (without the intervention of an extra phase, like disease germs). In that case, we might assume that we have two phases of the same component. But, to apply the rules the system must be in equilibrium and in general, while some pathological condition is spreading or declining the situation is obviously not one of equilibrium. Of course the presence of an external material factor that gets embodied in the cells will not lead us to believe that we have the same component. (Then again, we should have to consider whether the infecting agency is located in the cells, or whether it is causing the change from a remote corner of the organism by emitting a toxin. In the latter case, we still might possibly have a one component system).

Is a group of cells a solid, liquid or gaseous phase? Evidently it is neither—more of a gelatinoid phase. Are the boundaries going to give us difficulty in the creation of films between tissues? Probably they are important in most cases. Then, for all we know, everything up to now might be based by chance upon a correct assumption and this extended theory might still be useless if no example can be found in life, which satisfies all these conditions of simplicity.

For instance, in cancer, although we might assume at first one-component in two phases, the normal and cancerous, yet we rarely have a condition of equilibrium to begin with. Thus we are not certain of one-component, although we might be led to suspect it. If the cells of a tissue changed into cancer cells in the same sense that monoclinic sulphur changes into rhombic sulphur then we might say with reasonable certainty that we had the same component. However, it seems that cancer cells grow by multiplying amongst themselves and push out the normal cells, instead of being formed from normal cells. So we might have two components, and then we might not, considering the points of similarity between normal and cancer cells of a tissue. In support of the former view of two components, we have the remarkable difference in behavior of the two types. If it can be demonstrated that in some instances cancer cells are produced by transformation, then we shall deal with a one-component system. If not, we are in doubt as to how to regard it.* Then, a cancer is a system not in equilibrium and even if it were, the presence of loose cells and a blood stream capable of carrying these cells all around when they fall into it, makes any one see the almost insuperable difficulty of handling it right now, especially with no experimental verification for the simpler cases, which are more likely to be encountered in plant-life. However before taking leave, we might notice promising outlooks in that experimentally cancer was shown to be non-infectious, so we have no complicating outside material to deal with in adding extra phases and extra components. Then we might also point out a far-fetched analogy with the alleged pre-cancerous state which most researchers agree upon, which acts in conjunction with a chronic irritation to start the growth of cancer accelerated throughout the system. For the words "precancerous state" substitute the words "metastable condition of the normal cells" and for "chronic irritation", let us substitute "inoculating influence", such as crystals, rubbing, nuclei formation, which cause a supersaturated solution to crystallize out. For instance, the change of white tin to gray is facilitated by the presence of certain tin salts at low temperatures where white tin is the metastable condition. Similarly, the presence of a few cancer cells might set the transformation of the normal cells rolling along (assuming that normal cells → cancer cells and not that the latter are formed from themselves) when the organism is in this "metastable" state (or "precancerous condition"). This would fit in with a current theory that a few cancer cells always survive from embryonic days, only to burst into activity many years later, but only instead of being the primum mobile, in this hypothesis they are just the nuclei that cause the transformation to start when the body conditions are right.

As a matter of fact, we might be tempted to say that since $F = C + 2 - P$, and if a cancer is in equilibrium with cells we have a system of $F = 1 + 2 - 2 = 1$ degree of freedom. Since the body temperature is fixed at 98.6°F. the system has no degree of freedom and increase or decrease of pressure ought to alter one of the phases.

For further developments, experiment is necessary in order to confirm even the most fundamental hypothesis made here, that a large group of identically shaped and functioning cells, all continuous with one another, constitues a homogeneous phase. The experiments eas-

* Since the time this was written, the author encountered a weight of evidence which points to cancer cells as formed by a "mutation" of a normal cell, rather than by "transformation" of tissue, i.e., in favor of the 2-component idea. Thus the third from last paragraph should be read with that reservation.

iest to attempt are verifications of Le-Chatelier's law of stresses at equilibrium (including Van't Hoff's law* of mobile equilibrium that △ T causes reaction to proceed in direction of absorption of heat). Thus if 2 groups of cells were in equilibrium, one larger sized than the other, △ p** ought to produce more cells of the smaller variety and the coexistence of both sorts ought to be in accordance with the phase rule.

* Van't Hoff's law—P is constant.
** Pressure law—T is constant and this will probably be more significant in organisms of constant temperature.

LIVING & NON-LIVING SYSTEMS

Ralph S. Lillie

Biology is in a unique position among the natural sciences. It is not simply complex physics and chemistry, for living organisms have a psychological as well as a physical side. Even as physical systems their character is highly special, largely because their material substance is continually changing; perhaps it was from them that Heraclitus derived his idea that all is flow. The comparison with vortexes and candle flames is an old one. Wilhelm Ostwald (*Vorlesungen über Naturphilosophie,* Leipzig, 1902) included living organisms in his class of 'stationary systems'; they represent not a static but a kinetic equilibrium, what we now often call a 'steady state'; there is a balance of constitutive and dissipative processes. Materials and energy converge to the living centre, undergo there characteristic transformations, among which complex chemical and structural syntheses are conspicuous, and are again distributed at random to the surroundings. The living organism is thus the seat of a special type of physical and chemical activity found nowhere else in nature, and it is significant that this is associated with psychical activity—demonstrably in the higher organisms, by implication in the lower.

The main feature is synthesis. In all living organisms there is an orderly transformation of relatively simple materials taken from the environment, where they are distributed at random, into the complexly organized and active living being. What enters the system is unorganized; even carnivorous animals break down their food into simple compounds before they incorporate it. The materials thus assembled are recombined in a definite way, characteristic for each species. The integration conforms to a constant pattern; typically each individual passes through a life-cycle of a limited duration after which it disintegrates. Since during life its material is continually breaking down to yield free energy, there is always the necessity of replacement; accordingly the problems of maintenance, growth and reproduction, processes based on specific synthesis, are the fundamental biological problems.

During the last century a series of chemical discoveries (usually dated from Wöhler's synthesis of urea in 1928) were interpreted by many biologists as indicating that there was nothing in the physical and chemical constitution of living organisms that was necessarily peculiar to them among natural systems. And modern biochemistry and biophysics have been astonishingly successful in their analysis of single vital processes into known processes of inorganic physics and chemistry. The chemical distinction between living and non-living has largely broken down; almost any biochemical compound can now be synthesized, including polymers (polypeptides) which have all the essential properties of the simpler proteins. The conclusion is now unquestioned that living organisms (whatever else they may be) are to be regarded for many scientific purposes simply as physico-chemical systems of a special kind, to be investigated by the methods of physics and chemistry. Modern theoretical biology accepts this conclusion, while noting that it has reference to only one of the two sides of living organisms, the externally observable or physical, and disregards the 'inner' or psychological side.

Diffusion is the manifestation or effect of the undirected thermal motion of molecules; hence it is always *down* a concentration gradient; it is a dissipative process, making for uniformity; it tends to destroy any organization based on local differences of concentration or composition. As a constant factor, present in all fluid systems, it acts in opposition to what is perhaps the most characteristic physical activity of living protoplasm, the building up of complexly differentiated structure from dissolved molecules. To illustrate: solid protein structures (specific in constitution) are continually being built up in growing cells from dissolved amino acids. The concentration of the amino acid residues (R-groups) in the protein structure is much higher than in the fluid part of the protoplasm; hence the dissolved molecules must be moved up and placed in position against the resistance of diffusion. Just how energy is applied in moving molecules against concentration, or in sorting molecules of different species, so as to get the observed fine-grained differentiation, is a problem as yet unsolved. But processes of this kind are universal in living systems; the physiological process of secretion is a specialization of this kind of selective action.

In addition to the physical problem of the factors underlying this ability to perform selective work of concentration, there are the special biochemical problems presented by the metabolic transformation of the materials thus assembled. The general process to be explained is the transformation of a dilute solution of nutrients, consisting of randomly assorted molecules, into the organized living system. The physical prerequisites are: (1) an increase in the concentration of molecules, and (2) a selective distribution or sorting of molecules in accordance with a definite spatio-temporal (4-dimensional) scheme or pattern. These changes are preliminary to the chemical working-over or rearrangement constituting the special metabolic cycle of the system, through which its materials are transformed so as to produce and maintain the characteristic chemical organization.

Another fundamental biological fact is that the synthesis of the vital organization occurs only under the

* Extracts reprinted by permission from *Philosophy of Science,* Vol. 9, No. 4, 1942. The author is Professor Emeritus of General Physiology, University of Chicago. He has just published *General Biology and Philosophy of Organism,* University of Chicago Press, 1945.

direct influence of a preëxisting organization of the same kind—*omne vivum ex vivo*. In all species of animals and plants the factors of organization preserve a stable existence from generation to generation; this is the general condition to which the term *heredity* has reference, and the aim of the science of genetics is to specify these factors. Here again we find that the essential physical factors are of a physically small-scale character. Cytological investigation, in correlation with experimental genetics and biochemistry, gives ample evidence that the specific molecular configuration of certain nuclear proteins (forming part of the biological units called genes) is of crucial importance in determining the detailed course followed by the developmental synthesis. Cellular maintenance, as well as the growth and development of the organism as a whole, is also dependent on nuclear conditions. A large body of experimental evidence thus leads to the conclusion that in each protoplasmic unit an essential part of the organizing control emanates from a centrally placed aggregate of specially constituted materials . . .

. . . it is clear that the special features of the organization thus synthesized cannot be accounted for as an effect of simple increment of energy (although this is essential); a complete explanation would require a statement of how and why the energy is applied in a *directive* manner within the living system so as to give rise to its characteristic structural and other differentiation. The existence of the living state is dependent on a directed (integrated or organized) as contrasted with a random application of energy.

Let us now consider an integrative process occurring in a living organism where both physical and psychical sides are open to observation. Such an organism is one's own self. Take the simple act of writing a sentence with a pen on paper. As the words flow through the mind of the writer there is a corresponding flow of ink from the pen to the paper. We know experimentally that the processes by which the ink is deposited on the paper is adsorbed in the fabric, is fixed or dried there, and so on, are physically constant and definable with a high degree of exactitude, as phenomena of capillarity, adsorption, evaporation, etc. What happens physically is the same at every point traversed by the pen; a purely physical analysis would give a sufficient account of the process as it occurs locally; most details would be understandable in terms of physical cause and effect. But there is one feature in the writing which it would be difficult or impossible to explain physically, and that is the precise direction of motion taken by the pen at each point on its course. This direction determines what words are formed, and is itself determined by the mental or voluntary control of the writer as the words come into his consciousness. Nevertheless the act of writing [though originally derived from *conscious effort*] is itself largely automatic, and observation shows that in addition to the physical factors mentioned above there is a complex succession of physiological events, occurring in the nervous and muscular systems of the writer. Let us suppose that we analyse this physiological sequence into its physical and chemical components as completely as possible. All the analytically distinguishable materials and events of the sequence would appear as having constant characters, conforming to definite scientific conceptions. As we continue to resolve the single events into finer and finer small-scale components—ultimately with the aid of the electron-microscope—limits would eventually be reached to further physical analysis. The reason for this, according to our modern ideas, is that in the smallest observable field the events occurring in each minute spatio-temporal unit of volume would depend for their special character on energy-exchanges determined by quantum leaps, whose 'causes' could not be specified exactly in the individual cases. It is true that uniformities would be found, showing a correspondence or parallelism with the large-scale uniformities; but these would be scientifically characterized in terms of probabilities rather than of fixed quantities, and many single observations would be required to define them with exactitude, i.e., to determine the constant mathematical schemes (formula, type of curve, geometrical construction) to which they would conform.

It is to be noted especially that these sub-physical factors would also show a parallelism with the mental controlling factors, since both sets of events have experientially their constant characters and proceed side by side. The mental factors, however, are peculiar in having the comprehensive or integrative quality characteristic of 'mind' as such. It is the nature of mind to embrace the details of an experience and gather them together into a unity. Now it is just this unifying activity of the psyche which determines what occurs in the large-scale action, the writing of the sentence, even though the neuromuscular act of writing remains in its details subject to strict physical causation. This physical exactitude is an indispensable feature of the whole process; clearly, without such exactitude and dependability the act of writing would not be possible. The regularity or precision with which physical events are determined thus appears as a necessary *condition* of the writing; but physical regularity by itself cannot be regarded as the final determinant (in the sense of integrant) of the process, considered in its unified aspect as the expression of a thought on paper. A sentence is a mental occurrence; the separate words are held together in consciousness as a single experience or prehension through the unifying or apperceptive activity of the mind (Gestalt). A certain mental grasp is required to synthesize or understand (comprehend) a sentence; this means (among other things) to respond to it in a biologically effective or coördinated manner. The same is true of other experiences which involve a temporal or spatial span of consciousness, such as listening to a tune or looking at a picture. Both mental and physical factors are involved, and both are indispensable; but the act of integration appears mental rather than physical, however dependent it may be for its execution on physical factors . . . Here we recall Aristotle's distinction between final causes and efficient or motor causes, and his discussion of their biological interrelations in his books on the Vital Principle (*de Anima*) and Parts of Animals (*de Partibus Animalium*) . . .

No one could make a mass of plastic jelly into a rabbit unless the material possessed certain physical properties—of consistency, tenacity, and so on—determined by its special chemical composition and physical state. But equally the mass would not take on this shape of its own accord without the directive action of a conscious agent with a comprehensive survey and control over the totality of processes and conditions. It seems clear that, if all the observable factors playing a part in this morphogenetic process were considered and properly characterized scientifically, some would be regarded as physical and some as psychical. If the whole combination of factors were regarded as constituting a single system, this would be more accurately described as a psycho-

physical than as a merely physical or merely psychical system. The earlier example of writing a sentence illustrates the same principle.

We may say, then, purely as a matter of description, that the integrative factors observably at work in living organisms include in many cases conscious processes with their peculiar *quale;* these are associated with physical processes, e.g. those centered in the nervous system, and these are influenced, directly or indirectly, by other vital functions, all of which have their special physiology. The specialist may devote his investigation to one set of processes and disregard the other; but the other remains in effective existence nevertheless, plays its part. Few candid persons would dispute such an assertion when [it is] made in reference to a voluntary act of skill, like painting a picture; but in the case of many other vital processes, especially those of a vegetative or routine kind, like the action of the kidney or liver or the development of an ovum, the science so far developed has been exclusively physical. If psychical factors are present—or have been present in the evolution of these functions—they cannot now be demonstrated. What position is a general biology to take in such cases?

It is usual for the biologist to regard such processes from an exclusively 'mechanistic' point of view; each is a special instance of organic machinery . . .

What distinguishes true scientific knowledge is its reliability; the aim of physical science is often said to be to quantize nature, e.g. to represent it numerically as combinations of constant units, or geometrically as a framework of space-time relations. The dependence of synthesis on stable factors is clear from the examples already discussed; and a similar dependence must be assumed for integrative activity of any kind. Purposive action relies on the constancy of events; as Woodbridge puts it in his recent *Essay on Nature*, 'teleology and mechanism are correlative rather than opposed.'

Accordingly any regular complex process presupposes the physical constancy of components and sub-processes. But we have also to consider the rôle of the psychic factor in synthetic processes. Obviously in many kinds of human synthesis the special character of the synthesized product depends on the conscious aim of the synthesizer. A mental conception, or design, usually embodied in material form (e.g. a model, plane or blueprint) is necessary for any elaborate construction in architecture, engineering, science, or art. The design, once it is created, acts as a control on the activity of the workers; its function is directive as well as stabilizing; by reference to it one knows what to do next. Regarded scientifically, a design corresponds to a stable factor in the process under consideration; it may be compared with a physical stabilizer or governor through whose action any deviations from the desired course of events are corrected; the events are steered, so to speak, in a certain direction. Such a plan, in its character as integrative factor, has its physical as well as its mental side. If one wishes, one can look on the reactions of the builders to an architectural blue-print from a physiological point of view, as a series of neuro-muscular responses to visual stimuli; these responses would be the 'efficient causes.' Such a view, while partial, may be true, or scientific, so far as it goes; but it does not account for the process of construction considered as a whole, since it disregards the mental or psychic factor to whose integrative activity the design owes its existence (Aristotle's *final cause*) . . .

The question arises: can modern biology, using all the resources of modern chemistry and physics, make any essential advance upon the Aristotelian conception of vital action? This may be stated (briefly) in modern terms as follows: In life we have a combination of the regularly acting physical with the directive or integrating psychical. It is fair to say that Aristotle regarded the living organism as a psychophysical system.

Of course we understand in far greater detail than Aristotle could have imagined the psycho-chemical characteristics of living organisms, and biologists may still be found who speak of living systems as 'nothing but' physical systems. The realistic (or operational) meaning of this verbalism is that experimentally we find no limits to the possibilities of physical analysis and control . . .

The modern physiological conception of development may be summarized briefly as follows: The complete organism, with its constant psychophysical characters, is synthesized from unorganized materials collected from the surroundings. We find that this permanent biological process, or synthetic routine, is associated with an equally permanent set of physical or physiological conditions. Any specific ontogeny (e.g. of a man) represents a constant or regularly repeated sequence or cycle. This cycle shows great complexity of detail, but the single details all appear subject to law and have their constant or scientifically definable characters. Certain details, however, appear to be of special or critical importance, in the sense of holding what we call key positions in the ontogenetic sequence. There is ample experimental basis for assigning a dominating or controlling rôle to certain proteïns present in the cell nuclei, forming part of special structures long known and easily demonstrated microscopically, the chromosomes; the demonstrable relations of these structures to the specific biological characters form a large part of the modern science of genetics. The essential physical determinants of hereditary characters, the genes, are regarded as having their site in the chromosomes; chemically considered, the genes are (or contain) nucleo-proteïns; such proteïns are specific (in the immunological sense), and according to all the available evidence are present not only in the germ cells but in all the nuclei of the organism. This presence of the same set of specific biochemical compounds throughout the whole cellular organization indicates some special relation to integration. Such a constant condition must mean something; what we observe is a widely distributed and uniform biochemical character having a correlation with the pervading biological character or unity of the organism. It seems clear that in some way the genes exercise a regulative control over the processes of constructive metabolism by which the organism is built up and maintained. There is experimental evidence that they do this (partly at least) by determining (e.g. catalysing) the production of special biochemical compounds; thus the synthesis of certain enzymes or hormones depends on certain genes, and hormones are known to determine special features of the adult organization, e.g. whether the structural and psychophysical characters shall be of the male or the female type. (See *The Physiology of the Gene* by Sewall Wright, in Physiological Reviews, 1941. Volume 21, page 487.)

Development is usually regarded by biologists as a purely physiological process, the special course and integration of which depend primarily on biochemical

factors. I have already pointed out that not all cases of integration fall in the purely physiological category. In the adult animal (e.g. a man) the functioning of the whole organism as a biologically well adapted unity is demonstrably dependent in large part on psychological factors. It is true that these have their physiological correlates; a pain may have a definite symptomatic significance in the purely physical sense. Nevertheless such general facts remind us, whenever we are inclined to forget, of the special character of the living organism as not merely a physical but a psychophysical system; and they show the scientific insufficiency of a purely physical conception of the living organism. In the postnatal development of the child psychic factors play an obvious part (in the formation of habits, physique, character); there is, however, no direct scientific evidence of their importance in prenatal stages. (The popular belief in maternal impressions dies hard, although it has no support from science. There appears to be no scientific method of determining whether, or at what stage, psychic factors enter in the developing child *in utero*. But see St. Luke's Gospel, chapter I, 41-4). . . .

The psychic control over action is typically selective, or directive, in the teleological sense of aiming at conformity with some 'purpose'—some integrated plan, image or conception which is held in mind and depends for its realization on future physical action. Another consideration is important here: observation shows that in the various living (or psychophysical) systems found in nature the degree to which the psychic character, as such, is appreciable and enters as an effective factor in action, is not constant, but varies within a very wide range. This is true not only of the same living organism at different times, as seen in human experience, but seems especially true of the different species of organisms, if we accept as an index of the psychic the usual criteria of comparative psychology, such as memory or the ability to learn. All biologists—psychologists as well as physiologists—are agreed that the physical side of living organisms is a constant condition of their existence, one whose control never lapses, always present, and open to external observation at any time. In general, conservation, regularity, quantitative constancy, are the characteristics of the physical, as physical: it corresponds to the stable or routine side of natural process. (In Sydney Hooper's recent article on Whitehead's philosophy, *Philosophy*, 1942, volume 17, page 47, he describes the physical as a 'residue from the past.' The past, however, is no longer changeable; the purely physical corresponds to stable process which has shed subjective aim; it is 'completed process where the subject has perished.' In Whitehead, 'subjective aim,' the psychic, is an indispensable character of the vital, as vital. Cf. the essay 'Nature and Life,' in *Modes of Thought*, Macmillan, 1938). Conversely, the psychic (if we may judge from our own experience) is fluctuating and evanescent, as shown in sleep, attention, anaesthesia; it appears and disappears, varies in intensity, is qualitative and immediate in character, is associated with pleasure and pain. It is not always an active factor in the physical world, but appears to become effective as a directive and integrating agency chiefly when the originative or novelty-producing side of activity becomes important; e.g., when there is some special demand on the response of the organism, as when a new situation has to be met requiring some kind of non-routine activity; in brief, whenever the activity of the organism is of a kind in which integration is associated with some element of novelty, individuation or creation. . . .

Purposive activity is the antithesis of random activity; and a purpose (whatever else it may be) is in fact an integrator of activity. Such considerations indicate that the essential or primary biological rôle of the psychic factor in organisms is integrative; further evidence of this is seen in memory, a general psychobiological function which appears to be correlated with the degree of integration and is chiefly developed in higher animals. At this point we may again recall that the direct experience of mental life in each human being corresponds to a process of integration, since its distinguishing feature (as Kant emphasized in his Critique) is the unification or holding together of diverse conscious elements in a single field. We have seen that each living organism exhibits the physical property of bringing together from the environment disperse and randomly distributed material and energy and building up from these an integrated active system of constant type. It is reasonable to infer that this characteristic synthetic activity of living organisms has a direct connection with their special peculiarity of being psychical as well as physical systems. In other words, physical integration and psychical integration represent two aspects, corresponding to mutually complementary sets of factors, of one and the same fundamental biological process . . .

. . . I am confining myself to scientific considerations and forms of statement. Needless to say, philosophical issues lie behind, but I am not attempting to enter on these. What I have emphasized is simply that the essential distinction between living and non-living systems consists in the special development of synthetic and integrative activity in the former class, and that this special peculiarity is to be correlated with their possession, in an enhanced or intensified form, of psychical as well as physical characteristics. It is this close union or interfusion of both characters that gives living organisms their unique status in the natural world.

SEVERAL SIDES TO A FIT

Editorial Summary

EVEN TODAY the witnessing of an epileptic fit for the first time arouses feelings of shock and fear in an untrained individual. The "turning of the head and eyes; twisting of the trunk, extension of the back, repetitive flexor-extensor movements of the prime muscles of the extremities," as described by Dr. Temple Fay of the Temple University School of Medicine at Philadelphia, has conveyed to many people throughout history the idea that an invisible somebody or something has hurled the victim to the ground and is racking his un-

conscious body with torture. In old times and in primitive societies fits were and are considered to be caused by possession by evil spirits. Modern medicine has taken the view that an epileptic fit is a disease of the nervous system which should be treated as a disease without considering it a disgrace or of any religious or superstitious significance.

The production of convulsions for the treatment of some mental diseases in recent years has challenged physicians to a more fundamental inquiry into the nature of convulsions. Dr. Temple Fay has made a special study of epilepsy for several years and presents some provocative views in his paper: "The Other Side of A Fit" (The American Journal of Psychiatry, September 1942, pp. 196-200).

He attacks the problem mainly from two angles: (1) Why has it been necessary for "Nature" to evolve such a violent mechanism? and (2) What useful purpose could the convulsive mechanism have served?

Starting from the assumption that a seizure is a "latent reaction of defense" Dr. Fay traces it back into the neurological history of vertebrates. If a patient in a fit is put on his belly with his extremities in water it becomes very obvious that the movements described above correspond to the amphibian level of development. Doubtlessly, an important event in evolution was the emergence of land forms from saline surroundings. At this crucial stage, the "reflex of defense" (tail twisting, jerking, flapping and slapping) proved indispensable for the progressive individual would-be amphibian as a protection against the danger of running out of the required supply of oxygen and salts; the defense consisting in flipping it back into the water.

From this Dr. Fay draws the conclusion that a "fit" in man is a defense along the old and established rules when the organism is faced with profound changes in electrolytes and oxygen at the brain level. The purpose is the protection of the physiological economy against alterations in the basic formula of water, oxygen and certain salts, the final goal being re-establishment of normal physiology.

For this interpretation of a convulsive seizure as a "primitive integrated reaction of defense" Dr. Fay claims an "endless stream of evolutionary, symptomatic and physiological evidence." He himself stresses as the strongest argument in favor of the concept the failure of "skilled rotary or prehensile movements to appear in a major seizure." Seizure in an adult is essentially the same as in a child. The higher motor patterns evolved after the amphibian stage are absent, the controlling (inhibiting) influences of the brain have been removed and ". . . . a simple primitive motor pattern, free to respond without restraint, takes charge of the unconscious victim in a heroic attempt to save the day."

The long evolutionary transition of forms from those which lived entirely in the salty oceans to those which could survive on land is recapitulated at birth. As Dr. Fay says, "This moment of transition is a critical one—condensed into a few minutes, it represents the supreme achievement of Nature requiring untold millions of years in evolutionary struggle to bring forth a land-surviving type." This observation lends support to Dr. Fay's idea that neurological mechanisms necessary in the long evolution are likewise retained in the individual.

Dr. Fay concludes that it is erroneous to conceive of a fit as of a disease in itself. The task of the physician is to find the cause of this "primitive basic reflex," the source of disturbance of the physiological water-oxygen-salts economy, as it were, and then attempt to cure this. Dr. Fay also emphasizes the importance of impressing upon the layman that a fit is a symptom like any other and certainly no reason for "shame."

Dr. Fay's theory is inspiring but it has not found unquestioned acceptance. The main issue that demands clarification is whether the process in question—once vitally necessary in the evolution of vertebrates—actually still does fulfill the function of re-establishing physiological balance.

Dr. Paul H. Wilcox of Traverse City Michigan State Hospital, who has specialized in electroshock treatment of mental patients and has studied the convulsion reactions in detail, reaches conclusions almost opposite to those of Dr. Fay. (The Electroshock Convulsion Syndrome, The American Journal of Psychiatry, March 1944, pp. 668-673). He approaches the problem mainly from the following query: Are these convulsions really the result of "knocking out" temporarily the higher centers (what Dr. Fay calls "loss of cerebral control") allowing uninhibited brain stem patterns to appear, or are they not rather the result of excitation of the very brain centers themselves?

Careful experimentation with electroshock—as carried out by Wilcox and Friedman—seems to vindicate this interpretation. Dr. Wilcox's main contention is that, far from "knocking out" higher levels, the convulsion is primarily the result of integrated activity of the motor cortex. He analyzes in detail the pattern which would necessarily arise from generalized, rather evenly distributed excitation of the whole motor cortex, considering the strength of opposing muscle groups. Above all, it was found that the least current was needed to produce a convulsion if the stimulus was applied along the motor cortex. From this observation Dr. Wilcox considers the motor cortex as a "trigger zone" to which he ascribes a major role in all convulsions. The convulsion threshold of this "trigger zone" varies individually to a remarkable extent. Patients with the highest threshold require several times the dose required by patients with the lowest. Any excess of excitation that overflows from any other area may bring about the convulsion syndrome.

Further evidence for the contention that the electroshock convulsion is an integrated syndrome is drawn from the field of anti-convulsant drugs. Anti-convulsant drugs, such as sodium amytal, are used, on the one hand, to interrupt the status epilepticus; on the other, as an aid in interviewing catatonic patients. This latter application indicates that the "primary action" of sodium amytal is "on the highest integrative and inhibitory levels." Since, at the same time, this drug increases the convulsive threshold, it is justified to assume that the "trigger zone" itself "is at a fairly high level of cortical integration."

Finally, Dr. Wilcox deals with the state of unconsciousness which regularly accompanies epileptic fits and is partly responsible for the theory of the "knocking out of higher centers." "The nature of consciousness is poorly understood but a possible theory is that it depends on a certain minimal over-all integration of the various areas of the brain. If one area suddenly develops a complex excitation syndrome this may interfere with the minimal over-all integration . . . . ; . . . loss of consciousness . . . . may be merely due to the imbalance of cortical excitation."

So far it seems that one conclusion is common to both poles of this controversy: namely, that whatever the

causation of convulsions, the sensible thing to do is to look for the cause and not to attempt to cure the symptom. There are, however, farther reaching implications which Dr. Wilcox points out in a letter: ". . . . the fact that every human being, and I suppose every animal, can be given generalized convulsions by proper electrostimulation is an extraordinary fact. It probably has a simple explanation such as a natural pattern of overflow of excitation when certain areas are stimulated beyond a certain amount. However, the availability of such generalized excitation of all the nerve cells without much respect to previous habit patterns may be of profound biological and teleological significance."

G.M.K.

BOOKS IN REVIEW

THE WORLD SENSORIUM

Oliver L. Reiser

IN *The World Sensorium* Oliver L. Reiser returns with new vigor to his work of documenting a state of mind agreeable to science and acceptable to comparative religion, an enterprise limited to few but enlightening to many, as the reader will discover. For the public, Dr. Reiser's work had its firm beginning in his *Philosophy and the Concepts of Modern Science* (Macmillan, 1935), but his students at the University of Pittsburgh, and Pennsylvania citizenry nearby, have had deepening drafts from this mind for twenty years. For Dr. Reiser is a teacher of philosophy. (He is, nevertheless, also a philosopher.)

Eager readers everywhere, especially among the younger teachers in colleges, are familiar with the true and generous lines of his thinking. In this volume applications are made to the urgent world necessity of common concepts.

Those lines have always been inclusive, drawing together physics, biology, and psychology; they gather history to a focus; they have immediate social and ethical meaning; economic problems are kept within them, under view. When the physicists-turned-metaphysicians were explaining everything (except life, consciousness, and why the grass is green), Reiser was patiently working upon a proportionate whole. Now that logical atomism has given its message to mankind at Hiroshima, perhaps a great many more persons in posts of responsibility will heed a thinker who can derive programs and rules for a one-world society directly and cogently from his formal philosophy.

The World Sensorium deals with the conception, birth, growth, and cephalization of a world psychosomatic creature. The organic thesis is consistently developed. It displays the contents and attitudes appropriate if there is to be a world-soul suited to organized global society. It promotes with authority the visions of men like Comenius, Masaryk, H. G. Wells and others who have seen that mere economic and political truces make no world organism, because an organism is impossible without a psyche, and a psyche must include a moiety of mind if it be useful for human expression. Reiser discusses at once (p. 37) and with complete candor and freedom from partiality the difficulties which arise before the scientific thinker from dogmatic religion, and though it is not part of his program in this book to offer studies in comparative religion, he rests the case here upon "Walt Whitman's 'great individuals' from whom 'the rest follow'." He matches, in short, the inventor and technologist in the physical scene, making for physical unity through communications, with the spiritual and social inventor of cultural communications. That is to say, his uses of emergent evolution include super-physical mutations. He implies that matter can appear as new unstable elements, and he points to biological evolution, concluding that the new level, human mind, must be no less a projection of the underlying orginating resources for new species.

This brings the argument near to the core of the book, the third chapter, which expounds the idea of fields of force, familiar in physics and now being studied in biology as individuation fields, as a space-time matrix of new forms. In this case, the new creature is a world society, and the question before us is one of metaphysics and ethics: A scientific humanist is dissatisfied (for mass production society purposes) with the dogmatic and personal forms of "Christian morality," which end up as charity and paternalism. What can he expect will emerge for the morrow? Following the studies of the natural form of a free organic society deduced by Dodd and Kunz, Reiser sets up a vector diagram (p. 75) of the forces and styles in metaphysics and morality so far available to us, and describes a resultant from them: *Emergent* evolution is consonant only with a *creative* morality, a term charged with significance for anyone who is familiar with the present state of art, science, political effort, social anxiety, religious searching, and philosophical conceptual breakdown the world over.

The remainder of the book contains materials for this metaphysics and its appropriate morality, doing good by creating and not doing good by patronizing, let us say. And the work ends with a description of an institute for scientific humanism which could implement through studies the ideals of the United Nations Educational, Scientific and Cultural Organization. How otherwise is this new world body to call to its aid these really progressive world-minded philosophers who have the knowledge required to give form to the international studies needed to establish peace? UNESCO declares that wars are made first in the minds of men, and that peace must be made there first also. The contentious, critical, polemical verbalists are not our hope. Tough-minded types are needed, but we have a surplus of hard craniata, exoskeletons from the past, finished thinkers in both senses of that phrase. Reiser is one of a small group of men and women—physicians, artists, physicists—in whom the frontier spirit is alive, and who are, fortunately, growing in numbers. This book, (so also, *The Promise of Scientific Humanism,* and *Philosophy and the Concepts of Modern Science,* notably), displays the scope and penetration of such a mind in progress. The very fact that Reiser has not yet (we believe he would admit) brought off to his satisfaction the relation of emergence to matrix mechanics and

space-time geometry generally is promise that he may do so. It is such elastic strength, conjoined with gentle and yet relentless persistence, which is the very thing the world needs.

UNESCO is the hope of mankind, not UNO, and the intellectual visionaries are the hope of UNESCO. The American, Indian, Chinese and other UNESCO delegates from countries not too eaten through with lucrative logic are going to need help to put up a structure which will convince the Russians that there is reason as well political sense in restoring a Metropolitan to the social scene. They will need to have at hand talent which can cope with the thinking of a Vernadsky, in contrast (let us say) to the valuable but narrower doctrines of a Pavlov. The world sensorium could do from the start with a little epithelial tissue, particularly at UNESCO headquarters in Paris, where logic fortunately is not everything. For this purpose we recommend *The World Sensorium.* F.L.K.

THE WORLD SENSORIUM, Oliver L. Reiser, Avalon Press, New York, 1946. Previous works by the same author: *Humanistic Logic,* T. Y. Crowell, 1930; *Philosophy and the Concepts of Modern Science,* Macmillan, 1935; *A New Earth and a New Humanity,* Creative Age Press, 1944; *Planetary Democracy* (with Blodwen Davis), Creative Age Press, 1944.

SYSTEMATICS & THE ORIGIN OF SPECIES

Ernst Mayr

IT IS now some eighty-five years since Darwin wrote his "Origin of Species". During this period genetics has blossomed forth as a full fledged science and the older science of systematics has undergone a tremendous development. As a result we approach the problem of organic evolution with a vast body of data that was not available to those who pioneered the field.

Systematics and the Origin of Species follows an earlier book *Genetics and the Origin of Species* by Th. Dobzhansky in which he discusses the light which this new science throws on the probable mechanics of organic evolution.

Dr. Mayr's thesis reduced to a phrase is that new species develop largely if not wholly under conditions of geographic isolation. We quote: "A new species develops if a population which has become geographically isolated from its parental species acquires during its period of isolation characters which promote or guarantee reproductive isolation when the external barriers break down."

Dr. Mayr is an ornithologist. Birds are today far better known taxonomically than any other group of animals, it being estimated that 98% of all the species now living have been discovered and fully described. As a result one is in a position to make generalizations and draw conclusions concerning them that would not be justified by the present state of our knowledge of the taxonomy of other groups. Dr. Mayr is, however, well posted on the most important work which has been done on other groups of animals and wherever possible draws on this knowledge for such detailed examples as seem to throw further light on the matter under discussion.

The book itself is largely a documentation of the thesis stated above. First, however, Dr. Mayr traces the development of modern systematics the purpose of which is to name populations, not individuals, with its resultant shift in emphasis from the "type" specimen to the "series". Taxonomists now hold that just as no two individuals (barring identical twins) are completely alike either genetically or morphologically, so no two local populations are ever found to be identical, provided a minute enough analysis is undertaken, a reasonable enough assumption when one considers that a higher animal may have as many as 10,000 genes and an almost limitless number of morphological, ecological and physiological characters subject to variation.

These differences appear to arise as the result of two factors. First, the genetic composition of the original ancestors of any local population is never identical with that of the species as a whole. Second, mutations are constantly occurring which under the selective influence of the local climate keep accumulating until the local population becomes distinctly different from the parent population from which it sprang. Mutation is here being used in the now accepted sense, namely, a discontinuous chromosomal change with a genetic effect. It includes all the small genetic changes of which individual variation is composed as well as those changes which have potentially a selective value. Given the continual occurrence of small mutations and the fact that every single locality on the earth, even the smallest geographic district, is somewhat different from neighboring ones, in the nature of its environment, with differing biological factors, such as the absence or the greater frequence of enemies, parasites, or competitors, and we have a formidable array of selective agencies which will shape each population of a species to fit into the particular geographical and ecological niche in which it has been placed. Among some genera mutations seem to occur with considerable frequency and the species are then spoken of as "plastic"; other groups especially those of great geologic age seem today to be almost "static".

The evidence now available would seem to indicate that, so long as these slightly differing local populations are in actual contact with each other, interbreeding with its continuous exchange of genes between the two populations tends to retard if not prevent speciation. Given a sufficiently broad geographical range, however, the two ends of such a chain of intergrading subspecies can and do meet in the same area, and behave like two perfectly good species, with no interbreeding. At least in the case of birds and probably in the case of many other forms, it appears that the mobility of individuals is such that "swamping" prevents speciation unless fairly formidable barriers exist to keep a population separated. It is only under the conditions created by such a complete geographical separation that biological isolating mechanisms develop which will be capable of preventing any interbreeding if the populations later find themselves again in contact with each other. Richard H. Pough.

SYSTEMATICS AND THE ORIGIN OF SPECIES, by Ernst Mayr, Columbia University Press, 1942; 334 pp., $3.75.

SCIENTIFIC philosophy today is gradually drawing nearer and nearer to religion. It is an approach of hesitant advances and retreats, yet many real links have been made. Perhaps it is not too much to hope that one day there will be no divorcement whatever; that the problems of God, nature and man will be seen as inextricably woven together. The knowledge and experience of man will be enormously enriched when the factual evidence of science is wholeheartedly at the service of philosophy and religion, to corroborate man's age-old conviction that the universe is something greater than the sum of its parts, and that the order we perceive throughout nature is the result of law which is Divine in its origin as well as universal in its application.

Dr. Berman has made an unique contribution to this synthesis of science and religion. He has undertaken the difficult task of placing man in his proper relationship to the cosmic scheme. In the light of evidence offered by biology, physics, astronomy and the sciences of man, he has demonstrated by fact and close argument that purely mechanical theories of the evolution of the living organism are unsatisfactory and incomplete. Although scientific philosophy has generally made an important advance in isolating the life process, there has been too little distinction between the living and the energetic, or between the psychic and the physical. Dr. Berman makes this distinction adequately clear, and establishes life—what he calls the life-personality—as a thing in itself, unique, enduring and continuous.

Orthodox science today still holds about it the shredded remains of the mechanistic theory of evolution first formulated by Huxley, and describes the long history of the adaptation of species as mere mechanical mutations of structure and form. Yet a purely physical explanation cannot satisfactorily account for the delicate and sensitive adaptation to and use of environment which is a unique characteristic of the living organism. As Dr. Berman points out, the qualities of discrimination, assimilation and organization of experience, and integrity of the self are displayed by the living organism alone. These are all associated with psychation, and cannot be explained by concepts of inorganic physics and chemistry. Dr. Berman believes that the evolution of species exhibits "the characteristic psycho-activity—memory, awareness and direction—of a single superorganism properly called the life-personality". In this he is approaching the Eastern conception of evolution, which regards it as a process through which life as an aspect of Deity presses outward for more conscious expression through more responsive forms.

Dr. Berman views man against such a background of universal psychic order. It is interesting to note that he gives special consideration to problems which have so much engaged Oriental thought, and that he frequently arrives at similar conclusions, though by a very different road. For instance, he considers the apparent isolation of individual consciousness, and declares that the evidence of modern science proves it an illusion since man is identified by the genetic process with all that has preceded him in the universe, and must behold himself as part of a greater reality. The Indian view that all selves have their being in the One Self is not dissimilar. Again, Dr. Berman characterizes the nature of the living in a threefold classification, as matter, metabolism and memory. Indian philosophy describes the qualities of Self or Life (as contrasted with Not-Self, or material, energetic Nature) as *sat, chit* and *ananda*, which may be translated as mobility, thought and seeking, or, rearranged to correspond in order with Dr. Berman's classification, seeking, mobility and thought.

There are many other points in which Dr. Berman's ideas approach, from a modern scientific standpoint, the view of older philosophic systems. He describes the life-personality, in its forward evolutionary movement, as having found its fullest expression to date in the human species, which is self-consciously able to grasp "the links which bind it together as a whole and link it to the nether world of life." And from this point there is every reason to believe that evolution will continue its forward drive, perfecting in man the organs of psychation until he is able to perceive the fundamental realities of life in an intuitive flash. In this Dr. Berman agrees with the Eastern view that man, an unique departure in evolution because of his attainment of self-consciousness, is yet only on the way to a stage far greater and fuller by the achievement of soul powers unknown to ordinary consciousness. Of these intuition, direct perception, is one.

As for the cosmic stage upon which the drama of evolution is performed, Dr. Berman believes that it, too, shows evidence of plan and order. It is impossible that fortuitous chance alone could have brought together, in just the proper proportions and under just the right conditions, those particular chemical elements which are necessary to sustain life. In all this Dr. Berman sees order, plan and creative Intelligence: in fact, the God of cosmic evolution. And in its implications for man, Dr. Berman believes there will be a renaissance of the truly religious spirit when a real reconciliation is achieved between the individual and the community, based upon the realization of "co-consciousness with God". Dr. Berman's belief in the God of creative evolution is more than pantheism. It is much more akin to the lofty and impersonal Oriental conception of the Divine First Cause, the Rootless Root, the One-Without-a-Second—That, from which all worlds are born and in which all evolution proceeds; that Self in Whom all selves are united—undetached particles of Eternal Being.

It is a really remarkable achievement for a scientist, accustomed to viewing the world from the standpoint of the Many in all its intricacies, to be able to perceive the underlying reality of the One. Dr. Berman has accomplished a difficult task, and has made a fine contribution to that work which he himself considers so important: the imparting of a new insight to humanity.

E. B. Sellon

BEHIND THE UNIVERSE, a Doctor's Religion, by Louis Berman, M.D., Harper & Bros., 303 pp.